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Symposium Accents Growing Criticality of Operations Research

Army Science Conference Program Arranged

Attractions programed for the seventh U.S. Army Science Conference, June 16–19 at the United States Military Academy, West Point, N.Y., practically guarantee that it will be rewarding to some 450 Army key scientists and invited dignitaries.

U.S. Army Combat Developments Command CG Lt Gen George I. Forsythe will keynote the assembly with an address on "The Modern Soldier in His Current and Future Environment." General Forsythe is qualified to present some cogent observations on this theme, based on an illustrious career as a leader of combat troops.

Banquet speaker Dr. Ralph G. H. Siu will take on this role for the first time after contributing unforgetably as toastmaster to the success of five Army Science Conferences. His rollicking humor usually rocks the raft-

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Siple Medallion Slated As Conference Feature

Tribute to the memory of Dr. Paul Allman Siple, U.S. Army scientist recognized worldwide for a lifetime of distinguished Antarctic exploration, will take the form of a silver medallion for excellence in basic research at the 1970 Army Science Conference.

Mrs. Siple will make the first annual presentation of the Paul A. Siple Award, honoring her late husband, as one of the highlights of the conference at the United States Military Academy, West Point, N.Y., June 16–19. Each of the Army Science Conferences since 1957 has been held at the academy.

When Dr. Siple collapsed at his desk in the U.S. Army Research Office, Office of the Chief of Research and Development, Nov. 25, 1968, he

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4 R&D Facilities Selected For Project Reflex Tests

Project REFLEX, a demonstration project involving 10 Department of Defense in-house R&D laboratories to test the concept of using fiscal controls alone instead of combined fiscal and manpower controls, is scheduled to begin July 1.

Four Army research installations have been selected for the experiment, namely the Harry Diamond Laboratories, Washington, D.C.; Mobility Equipment Research and Development Center, Fort Belvoir, Va.; Electronics Command Laboratories, Fort Monmouth, N.J.; and the new Air Mobility Research and Development Complex, headquartered at St. Louis, Mo.

Project REFLEX is one of a series of actions in recent years to improve Department of Defense in-house lab-

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Accented as one of the paradoxes of our times in the U.S. Army Ninth Annual Operations Research Symposium, May 20-22 at the Army Research Office—Durham, N.C., is that operations research daily touches importantly upon lives of many millions but is still an emerging, imperfect science.

Department of Defense agencies and virtually every large industrial firm in the nation are—because of the magnitude and ever-increasing sophistication of design and production requirements—depending ever more critically upon operations research as an indispensable art, it was stressed.

Scanning of the register of 200 participants in the conference showed few names not prominently identified as a key official, scientist, project leader or administrator of defense, industrial and academic organizations in the United States, England, Canada and Australia.

Introduced by Army Chief of Research and Development Lt Gen A. W. Betts, sponsor of the symposium, keynote speaker Lt Gen Henry A. Miley, Deputy Commanding General of the Army Materiel Command, discussed how the techniques of simulation and modeling used in operations research

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Gribble Returns as Deputy CRD; Rowny Heads I Corps

Senate confirmation of President Nixon's nomination of Maj Gen Edward L. Rowny for 3-star rank, coincident with assignment as commanding general of I Corps, U.S. Army Korea, was announced at press time.

Maj Gen William C. Gribble has succeeded General Rowny as Deputy Chief of Research and Development, returning to the position he filled from April 1966 until he succeeded Lt Gen Harry W. O. Kinnard as Deputy Assistant Chief of Staff for Force Development in July 1967.

General Gribble had served since Apr. 15, 1969, as CG of the Army Engineer School and Fort Belvoir, Va.

General Rowny became Deputy CRD Sept. 2, 1969, filling a position vacated by Maj Gen Robert E. Coffin when he left Mar. 2 to head

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Maj Gen Edward L. Rowny

Maj Gen William C. Gribble

Featured in This Issue . . .

Army R&D Newsmagazine

Vol. 11, No. 4 • May-June 1970

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Purpose: To improve informal communication among all segments of the Army scientific community and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among Army R&D activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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Betts Gives Section 203 Views to AFIP Board

In recent months Section 203 of the 1970 Authorization Act, by which the U.S. Congress required that all Department of Defense basic research must have military relevancy, has resulted in a thorough review of all ongoing research programs. Army Chief of Research and Development Lt Gen A. W. Betts explained why he believes Section 203 restrictions should be changed in addressing the Armed Forces Institute of Pathology Advisory Board at an Apr. 30 dinner in the Walter Reed Army Medical Center, as follows:

* * *

On the 12th of August last year, during Congressional debate over the FY 70 RDTE Authorization, an amendment offered on the floor of the Senate called for tighter controls over research supported by the Department of Defense. As finally passed, that amendment read:

"None of the funds authorized to be appropriated by this Act may be used to carry out any research project or study unless such project or study has a direct and apparent relationship to a specific military function or operation."

Initial reactions to this amendment on the part of those involved in defense research ranged all the way from: "Well, that's the end of defense support of basic research" to: "We see no problem; we have always demanded relevancy."

Tonight I would like to discuss my own assessment of the implications of this amendment—now well known as Section 203 of the 1970 Authorization Act.

It is very important that we try to understand the rationale behind this amendment. I am sure that part of the reason came simply from a desire to reduce military expenditures. For an economy-minded Congressman, or one seeking a source of funds for other purposes, large sums for support of research make a very tempting target. General arguments about the necessity to support a strong research program just do not have much public appeal.

I am sure that I do not need to tell this audience that it is common knowledge that there is rarely an immediately visible payoff from research. Unfortunately, immediate needs always take precedence over the long term, and research is long term by nature. So, when funds become tight, it is inevitable that research support will suffer, unless one can relate it to a near-term problem or a clearly demonstrable need.

Perhaps we have been our own worst enemies, in a way, by our failure to recognize the importance of careful choice of titles for our research projects. The case comes to mind of one of our smaller research efforts, one that is probably well known to this group. The project deals with migratory patterns of birds in Asia, as part of a larger program of Migratory Animal Pathology Study.

Small wonder that this project was questioned by a Congressman who challenged the relevancy of bird migration patterns to Army missions. On the face of it, the question was a good one, and even a well-informed Congressman, a staunch supporter of our military research effort, was hard put to defend this project. To the experts, the relevancy was very clear—a correlation of disease vectors with areas of possible Army operations. As a result of this work, the medicos now tell me that there is some evidence that swallows may be carriers of Hemorrhagic Fever in Southeast Asia. What could be of more vital concern to American military forces? Without such knowledge, how could we be prepared to operate in areas of the world where such diseases are endemic?

Obviously, we do need to pay more attention to titling research projects. It would be helpful if military relevancy could be clearly indicated, but I recognize that this is rarely possible. To be useful, titles should be brief and indicate the subject matter. It is a little too much to expect them also to postulate how the results might ultimately be applied, yet that is the problem posed by Section 203.

Dr. Richard A. Weiss of my staff gave me a recent example of the extent of the titling problem. He told of a chance conversation with a fellow air traveler, a biophysicist. Dick Weiss asked what his specific area of interest was. The chap answered that his speciality was bioelectricity, the study of the phenomena associated with those species of organisms that are able to generate an electric charge.

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may be used more effectively for military systems—involving billions of dollars a year.

Testing in the military weapons systems life cycle of research, development, test and evaluation, General Miley said, accounts for a very substantial part of the total cost prior to production—in some programs as high as about 40 percent.

Effective simulation and modeling techniques, he said, present the hope of important economies, thereby "improving our R&D posture considerably."

Banquet speaker George B. Gerrish, director, Systems Operations, IBM Federal Systems Division, scored impressively, as judged by resounding applause, in detailing how operations research techniques are affecting the lives of millions of Americans in almost every product they use.

Audience empathy was established in his first sentence when he said:

"I am told that you are a 'pragmatic lot, unhampered by straight-laced traditionalism, and by nature inquisitive, free thinking and eager to accept a new challenge.'

"I can't really take any credit for that definition of 'OR' people because, as some of you might recognize, it comes directly from your Operations Research Society booklet, *Careers in Operations Research*, and it put in clear perspective for me the group I am addressing tonight.

". . . I would like to examine with you where we are in technology and how we got there, where we're going and some of the problems that face us as we make our Pilgrim's Progress in this new decade." (This was a reference to amazing progress that has been made in developing operations research techniques within the short span of a decade.)

"The area of modeling and simulation has become particularly important," he continued, "to businesses in their decision-making processes. When one awakens in the morning to his electric alarm clock or clock radio, he doesn't stop to think there is a high probability that the total power network feeding his electric clock has been modeled many times and in many ways.

"In order to properly understand the interrelation of each of the power company's networks, and of the generating systems providing power to these networks, modeling is essential. For example, the generating system has been modeled to determine optimum points of fuel cutover from soft coal to natural gas or oil, etc.

PARTICIPANTS AND DIGNITARIES at 9th Annual U.S. Army Operations Research Symposium included (from left) Dr. Frank E. Grubbs, chief operations research analyst, Aberdeen (Md.) R&D Center; Dr. Marion Bryson, technical director, Institute of Systems Analysis, U.S. Army Combat Developments Command; Brig Gen George M. Snead Jr., director of Army Research, Office of the Chief of R&D; Prof. Ronald W. Shephard, head of Ballistics and Operational Research Branch, Royal Military College of Science, England; Col. William P. Broderick, Australian Army representative in Washington, D.C.

"When you turn on your television set, remember that modeling has also taken place in programing. In fact, we have gone from modeling to real-time applications in the use of computers in scheduling of all the resources associated with the production of television programs.

"This application was first modeled and is now in operational use at the Japanese National Broadcasting System many thousands of miles from us here this evening. There, when a director arrives in the morning, he first goes to a console operator who gives him a complete schedule of his activities for the day. This schedule indicates which studios should be used, what equipment will be made available in these studios, and what production assistance will also be available in these studios.

"Passing to the breakfast table, when one thinks of a common menu such as juice, bacon, eggs and toast, one of the last things that comes to mind would probably be computer models and simulation.

"But, if we think about it for a moment, we recognize that the trucking company that brought us the fresh juice from Florida may well have used a model for optimal truck scheduling, the hen who didn't lay the golden egg laid white ones for us based on models of optimal feed, and the pig who produced our breakfast bacon was fed to optimal size in optimal time by an optimally selected group of feeds provided by computer simulation.

"And so the story goes—out the front door into the automobile, where operations research has played a major role in the design, development and manufacture of our transportation equipment. Thus, minute-by-minute, hour-by-hour, our daily lives are touched in both minor and major ways by systems simulation modeling and analysis techniques, many of which are unknown to the average citizen.

"As always, when we look to the future, we wonder what is in store, and we realize that the future will be shaped by certain forces upon it. I like to think of these forces existing as pressures in two areas—technology development, and application development.

"There continues to be significant pressure for larger and larger machines, machines that will operate at higher and higher rates of speed with more and more memory. Technology pressures for these types of machines result fundamentally from unsolved problems.

"There are massive problems facing us in such areas as weather prediction, where ideally we could structure a model of the world's atmosphere and exercise this on a very frequent basis. We recognize that this requires a very large machine with high computational rates and vast amounts of storage. The need for simulations and models in the areas of nuclear physics, molecular chemistry, and air and water pollution creates pressure for very large machines.

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"As an aside, it's interesting to note that the almost-tragic flight of Apollo 13 was brought to a safe landing primarily through the use of simulation techniques. As some of you may know, our people in Houston did the programing for the Real Time Computer Complex, which handles the ground support computational load for the Mission Control Center there.

"As soon as the first problem was detected on the Apollo flight, a crew of trained astronauts was brought into the flight simulation area, and each of the instructions that was later given to the men in space was first tested in a simulated environment with an actual spacecraft.

"Thus, in each instance, Mission Control had the opportunity to test ideas and the reaction of the astronauts to the directions prior to transmission to the crew in Apollo 13. Put simply, simulation was a major factor in assisting the safe return of the crew of Apollo 13. I apologize for that digression, but I thought you might find it interesting.

"Not only is there continual pressure for larger and larger machines; there are also other technology pressures, as noted before—the pressure to get more and more memory; pressure to create memory technology that will eliminate mechanically driven storage devices; pressure for more reliability; pressure for redundancy; pressure for greater integration of circuits; and pressures for all types of self-diagnostics, error detection and control.

"As a result of the size reductions in technology resulting from such things as large-scale integration, we have a whole new set of pressures.

ARMY REPRESENTATIVES during coffee break at Operations Research Symposium (from left) Lt Col Edgar G. Hickson Jr., CO of the U.S. Army Research Office-Durham; Lt Gen Henry A. Miley Jr., Deputy CG, U.S. Army Materiel Command; Lt Gen A. W. Betts, the Army Chief of R&D.

Those pressures come about through the ability to produce a new family of mini-computers. Here, we see pressure building for terminals—terminals that may well be not only redundant, but highly reliable and, indeed, can perform logic functions which were never previously possible because of size and cost factors.

"There continue to be other pressures, and these are basically application pressures. These, to me, are the key items of the future. For no longer is technology necessarily the gaiting item in application development. There is pressure for the development of common languages and data formats in the scientific areas, in electronics, physics, chemistry, medicine, and many, many others."

After a brief discussion of possibilities and problems of interrelating all aspects of personnel data, permitting "examination of vast segments of the population for early diagnoses of potentially dangerous or fatal conditions," Mr. Gerrish continued:

"In the world of operations research, more and more modeling and simulation efforts are taking place in an attempt to determine the impact of social programs. Applying these techniques to the social sciences in both the government and the universities has become extremely important to help assess the impact of decisions in social security, taxation, welfare, etc.

"There are two significant aspects of this type of application. The sheer magnitude of these problems makes it extremely important to have a valid and, hopefully, independent data format and structures.

"To expand slightly on these points, I am sure everyone in this room recognizes that the results of our activities are a function of the validity of the models, and valid models are not easily achieved. We have all had experiences where the assumptions were deeply buried and the model was poorly related to the world we were examining. Consequently, the results were of very little value.

"By the same token, ideally we should have a data base functionally organized so that it is totally independent of the model, the hardware, and the programing systems. This allows us more flexibility in applying the data. For example, in designing a transportation model, we don't necessarily need to have the complete characteristics of each intersection and bump in the road. The model can be designed using only the links and nodes of the system."

After discussing some of the problems of computer development, and touching upon security, privacy, administrative and legal aspects, Mr. Gerrish concluded with:

"In the operations research area, we need to build valid models and structure data bases that are independent of the model and the computing and programing system. This is essential to success in developing the programs of this decade.

"In summary, I really feel that technology of itself will not be the pacing item of the future. This lies in the very minds of the people who are using the computer as a tool. The

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SHARING INFORMAL DISCUSSION at Army Operations Research Symposium are (l. to r.) Col William J. Lynch, assistant director of Army Research, OCRD; Col Louis F. Dixon, Information and Data Systems Office, Office of the Assistant Chief of Staff, Force Development, HQ DA; Dr. Theodor W. Schmidt, U.S. Army Research Office-Durham; George B. Gerrish, director of Systems Operations for the IBM Federal Systems Center, Gaithersburg, Md.

Scenes at . . . 9th Annual ARMY OPERATIONS RESEARCH Symposium

(1) PANEL ON STANO SIMULATION, Lt Col G. E. Galloway, Michael A. Benanti, Lt Col Harold W. Moye and Raymond V. Attarian. (2) EDUCATIONAL LEADERS, Dr. L. G. Callahan Jr., Georgia Institute of Technology and Prof. Marcus Hobbs, provost, Duke University; Dr. William W. Hines, Georgia Institute of Technology. (3) RECEPTIONISTS Judith Hightower (left) and Patsy Ashe get "well-done" embrace from Australian Army Col William P. Broderick. (4) SHARING RELAXING MOMENTS (from left) Miguel Carrio, Mallard Project, Fort Monmouth, N.J.; Raymond J. Astor, New Cumberland (Pa.) Army Depot; Dr. Walter E. Sewell, ARO–D; Brig Gen John R. Jannarone, U.S. Military Academy, West Point. (5) Maj W. J. Stephens, Office, Assistant Chief of Staff for Communications-Electronics, DA; Dr. Lee Sanderson, Honeywell, Inc.; Lt Col Harold E. Collins, Office of the Vice Chief of Staff, U.S. Army; Richard H. Riel, Test and Evaluation Command. (6) Col Charles B. Hazeltine Jr., Combat Developments Command; Ray E. Rudolph, Falcon R&D Co.; Charles Allen, Research Analysis Corp.; Steven D. Corbin, Litton Systems.

Army Science Conference Program Listed

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ers. This year his message is expected to convey also much of the depth of his knowledge as a retired Army scientist, backed by over 25 years of exceptionally distinguished service.

Army Chief of Research and Development Lt Gen Austin W. Betts demonstrated his talents as a toastmaster at the 1966 Army Science Conference, when he was called upon to pinch-hit for Dr. Siu, and will again be the master of ceremonies.

Assistant Secretary of the Army (R&D) Robert Louis Johnson is programed to present Certificates of Outstanding Achievement for top-rated technical papers in his first appearance at an Army Science Conference.

Cash honorariums, aggregating $3,500 to $4,000, will be awarded also through the Army Incentive Awards Program. (See separate article, page 1 for the initiation of the Dr. Paul Allman Siple Silver Medallion and bronze medallions bearing the Army Research Office crest.)

Expected to provide one of the major attractions is a panel discussion on "How Do You Determine Your Research and Developments Needs?" Army Materiel Command Director of Laboratories Dr. Robert B. Dillaway will preside.

Except for Dr. Alvin Gorum, technical director of the U.S. Army Material and Mechanics Research Center and a former distinguished member of the academic community, members of the panel all are distinguished industrial leaders.

Dr. Arthur M. Bueche is vice president, Corporate R&D Division, General Electric Co. and Dr. Henry Lee is executive vice president of Epoxylite Corp. Other members are Harold W. Duchek, vice president for Engineering and Research, Emerson Electric Co.; Wilmer A. Jenkins, research director, Explosives Dept., E. I. du Pont de Nemours & Co.; and Richard S. Schreiber, vice president for Corporate Research, Upjohn Co.

General Betts, as sponsor of the ASC, and Maj Gen William A. Knowlton, superintendent of the U.S. Military Academy and host to the meeting, will join in welcoming conferees. General Betts also is on the agenda to discuss Army research and development programs, problems and goals.

Army Chief Scientist Dr. Marvin E. Lasser is presiding chairman and Dr. Richard A. Weiss, Deputy and Scientific Director of Army Research, will call the meeting to order as general chairman of arrangements. Director of Army Research Brig Gen George M. Snead Jr. will follow with introductory remarks.

One hundred technical papers are programed for presentation during five concurrent sessions, each organized into five subsessions.

Session chairmen are Dr. Craig M. Crenshaw, Army Materiel Command chief scientist; Dr. Gilford G. Quarles, chief scientific adviser, Office of the Chief of Engineers; Dr. J. V. R. Kaufman, deputy director, Plans, Research, Development and Engineering Directorate, Materiel Command; Col Helmuth Sprinz, director, Division of Experimental Pathology, Walter Reed Army Institute of Research; and Dr. Robert B. Watson, chief, Physics, Electronics and Mechanics Branch, Physical and Engineering Sciences Division, Office, Chief of R&D, HQ DA.

Project officer is Dr. John C. Hayes, U.S. Army R&D Information Systems Office, assisted by Col Albert L. Romaneski, deputy chief, Environmental Sciences Division, OCRD.

MICOM Honors 17 With S&E Awards

Scientific and Engineering Achievement Awards, announced June 1 by the Army Missile Command, recognized 17 personnel in the Research and Engineering Directorate, marking conclusion of six successful research projects aimed at more efficient, less costly weapons.

Maj Gen Edwin Donley, CG of MICOM, told the recipients during the awards ceremony that they had materially enhanced the Army's technical capability and had established a scientific basis for improvements of military importance.

Projects were divided equally between the Propulsion Laboratory and the Inertial Guidance and Control Laboratory and Center. Honored from the Propulsion Lab were Henry Allen, Marjorie Cucksee, Bernard Alley, Pfc James Dake, Robert Fink, William Thomas and Robert Betts.

Allen and Mrs. Cucksee were recognized for their work in the development of a new binder system for composite solid rocket propellants; Alley and Dake were cited for research in controlling the burning rate of such propellants.

Combined efforts of Fink, Thomas and Betts resulted in the design of an essentially debris-free ignition system for stick propellant motors. Application of the system on the TOW has alleviated some problems.

Guidance and Control Lab personnel cited for outstanding contributions included John Leonard, Thomas Wetheral, Walter Jordan, Bobby Clayton, Roland Morris, Victor Ruwe, Hugh Greene, William Stripling, Harold White and James Johnston.

A serious problem in the turret control system of the M–60 tank was the basis of the awards made to the first five. They combined talents in developing a reliable and cost-effective system that greatly improved the stabilizer performance of the turret.

Engineers Ruwe and Greene won achievement awards for their study in the area of nuclear effects on electronic systems and their subsequent recommendations for improved procedures. They established new techniques for performing susceptibility determinations for complete missile systems, and developed methods for making the systems less susceptible to nuclear radiation.

Stripling, White and Johnston contributed to solutions of serious alignment problems with a missile system. They supervised the implementation and evaluation of a new system that greatly reduced skill requirements for operators, cut the reaction time and exceeded the accuracy requirements.

R&D Facilities Selected For Project Reflex Tests

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oratories. Several committees studying in this area have reported the need for greater flexibility at the laboratory director level, to increase responsiveness as well as to decrease the administrative burden.

Another effort, for example, is Single Program Element Funding, being tested in FY 1970 and 1971 at the Army Missile Command Laboratories. Under this concept, funds are given to the laboratory director so that he can operate under one program element rather than several separate projects. Thus he does not have the administrative burden of reprograming funds between Department of the Army projects when requirements and priorities change.

Project REFLEX, similarly, will operate under fiscal controls only, and will not be subject to manpower spaces or surveys. The intent of the project is to increase the management flexibility available to the laboratory directors, and to observe how they respond to this increased flexibility and corresponding responsibility.

The plan of the demonstration project is that Project REFLEX will continue for three years. Based upon results, it then may be expanded to apply to other Army and Department of Defense laboratories.

Dr. Siple Medallion Slated as ASC Feature

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had served since 1946 as an Army scientist, except for a 3-year tour of duty with the U.S. Department of State as a cultural attache in Australia (June 1963–June 1966).

Before a gathering of about 450 Army key scientists, other U.S. Government research and development leaders, and representatives of four nations linked in the Quadripartite Agreement on mutual defense R&D effort, an Army in-house laboratory scientist, or perhaps a team of researchers, will be recognized with the Paul A. Siple Award for a technical presentation.

Bearing a likeness of the famed explorer as he was depicted on the front cover of *Time Magazine*, Dec. 31, 1956, in recognition of his service to the U.S. Antarctic International Geophysical Year Program, the silver medallion is considered by the U.S. Army Institute of Heraldry to be one of the finest and most intricately designed medallions it has created. Designer and sculptor is Lewis J. King Jr.

In addition to the medallion, the top-ranked technical paper will be recognized with a $1,000 cash honorarium through the Army Incentive Awards Program, which is expected to recognize excellence in research with a total of $3,500 to $4,000 at the conference.

One hundred technical papers, selected from some 550 narrative proposals submitted by Army in-house laboratory researchers, will be presented. Another 21 papers have been chosen in a supplemental category—for possible presentation should any of the other papers be withdrawn.

Supplemental papers also may be judged for the awards that will give recognition to an anticipated 10 to 15 papers in the final evaluation. All of the 121 papers thus have an opportunity to vie for honors.

Another new honor this year will be a 3-inch medallion cast in bronze, sculptured with the U.S. Army Research Office coat-of-arms. How many of these handsome new medallions will reward authors of meritorious papers had not been announced at press time.

Eulogies of the press throughout the nation to Dr. Siple accumulated on the desk of the editor of the *Army Research and Development Newsmagazine* during more than a year following his death of a heart attack.

In this impressively massive tribute, one of the finest was by a lifelong friend and Army Research Office associate, Dr. Leonard S. Wilson, chief of the Environmental Sciences Division, published in the Annals of the Association of American Geographers, Vol. 59, No. 4, December 1969, pp 815–819.

When he died at the age of 59, Dr. Siple was president of the Association of American Geographers—a fitting climax to the illustrious career fashioned by a hardy, intrepid and courageous adventurer following his selection from 826,000 Boy Scouts to accompany Admiral Richard E. Byrd on his first Antarctic Expedition, 1928–1930.

In his tribute, Dr. Wilson writes:

"During Dr. Siple's 40-year career, he engaged in field research on seven continents, accumulating scientific information needed to interpret the impact of the total physical environment on man and his possessions.

"This broad spectrum eventually centered on military problems and became identified with the term he coined—Environmental Research. Although he is best known for his work in cold regions, he was equally active between Antarctic expeditions in the study of man in relation to the desert, the humid tropical and the high mountain environments. His wide-ranging curiosity and broad grasp of the physical sciences led him into many of the less-understood aspects of the earth's climatic and terrestrial features and resources.

"Siple was not content with the passive descriptive observations that characterized much of the geographical literature of his generation. Rather, he sought to understand "why?" as well as "what?" and "where?" His investigations ranged from identification, analysis and classification of Wind Chill, as it affects man, to a prolonged study of the reasons underlying the precession of the earth's spin poles.

"A major enterprise was ENVANOL, an early successful attempt to classify natural and man-made geographic conditions as these factors affected military operations. It preceded the wide use of computers, and in various guises still is used with increasing success . . . ."

Dr. Wilson's eulogy perhaps may be appropriately complemented by two paragraphs from the *Army Research and Development Newsmagazine* article that recounted Dr. Siple's courageous fight against a partial paralytic stroke June 6, 1966, while he was on duty in Wellington, New Zealand, as follows:

Up to the time of his death he moved, about slowly, painfully with his left arm in a sling and his right hand grasping a 4-legged crutch. But his determination to overcome his difficulties, his will to continue to make a notable contribution to Army research and development as a scientific adviser with a great depth of knowledge, never failed—nor did his famous smile and the ready humor that endeared him to friends throughout the world.

"Splendid sagas usually are fictional, a part of the treasured folklore of a nation, but Dr. Paul Allman Siple lived his saga as an internationally famous polar explorer, scientist, inventor, author and pioneer in Army research and development right up to his death Nov. 25 . . . ."

Col Grimm Assigned as DCofS for T&E at APG

Col Henry F. Grimm Jr. was assigned recently as deputy chief of staff for test and evaluation, U.S. Army Test and Evaluation Command, Aberdeen (Md.) Proving Ground.

Following a 1963 tour with the Office of the Chief of Research and Development as chief of the High Altitude Systems Branch, Air Defense Division, Col Grimm was assigned to the Defense Department's Weapons Systems Evaluation Group in Washington, D.C.

Col Henry F. Grimm Jr.

After serving in Vietnam as commander of the Nha Trang Subarea and the 54th General Support Group, he returned to the Pentagon in 1967 for duty with the Office of the Assistant Chief of Staff for Intelligence. He was serving in the Office of the Army Chief of Staff, STANO Systems Office, when selected for his present assignment

Col Grimm graduated from the U.S. Military Academy in 1943, earned an MA degree in international relations from Ohio State University in 1950 and in 1958 received an MS in mechanical engineering from the University of Southern California.

He was battalion commander of the 4th Missile Battalion (Nike Hercules), 44th Artillery in Korea (1961–62) following three years as Sergeant and Corporal project officer, Artillery Board, Fort Bliss, Tex.

'Drake Debate' Features Pros, Cons of Defense Procurement

Billed as the "Drake Debate, forensic event of the season," a recent discussion of pros and cons of defense procurement tied to the Army materiel life cycle, chaired by Deputy Chief of R&D Maj Gen Edward L. Rowny, was a spirited exchange on a long-controversial subject.

Guest of honor as a participant in the session in the Pentagon, Washington, was Hudson B. Drake, director, President's Commission on White House Fellows, consultant to the President's Advice Council (Science and Technology), and Administration and Operations Manager for the Electronics Systems Division, North American Rockwell. He joined NAR in 1958 and is currently on leave of absence.

Most personnel throughout the Department of Defense linked to any phase of research, development, test, evaluation and procurement of military materiel have been made well aware of "Major DoD Procurements at War with Reality." Author Drake presented his views in the *Harvard Business Review*, January-February 1970, and the "great debate on Drake" was off and running.

Weapons systems acquisition procedures in the Defense Department in the current financial "funorama"—trying to buy more with less money in a period of spiraling costs—have been under penetrating ponderation.

One of Drake's contentions is that the DoD contracting policy for highly advanced systems is not realistic, and that "it is less than satisfactory." He says the situation is of concern to business firms at large "because the government is likely to repeat this error, in other areas now and in the future," as though technologies in these systems were well in hand and no unexpected problems could arise.

In the *Harvard Business Review* article, he early makes salient points:

• "Our defense posture depends on such highly advanced systems. In the absence of a general arms ban, the DoD must have effective and efficient methods for procuring them.

• "These methods tend to be used as models for transactions elsewhere in the business-government interface. Thus, although they have their primary impact on the major companies in the so-called 'military-industrial complex,' they also affect government-industry relations wherever the government must buy solutions to advanced technological problems, as in the fields of nuclear energy (AEC), aeronautics and space (NASA), aviation (the SST project), transportation (the Metroliner project), communications (satellite systems), environmental control (desalination and like problems), and so forth."

DRAKE DEBATE participants assembled recently at the Pentagon to present views on pros and cons of defense procurement tied to the Army materiel life cycle included (from left) Lt Col John P. Haumersen, Maj Gen Edward L. Rowny, Lt Col John F. Wall, Hudson B. Drake, Col Robert E. Lazzell.

Forensic talent and operational procurement know-how in the Office of the Chief of Research and Development, HQ DA, was lined up into two teams for the punch and counterpunch session to debate Drake's contentions. Present for the debate were numerous top officials from Army R&D and Office of the Director of Defense Research and Engineering, DoD.

With Lt Col John F. Wall serving as action officer in setting up the debate, Col Robert E. Lazzell of the OCRD Plans & Policy Division was chosen to head Team A and Lt Col John P. Haumersen of the Management and Evaluation Division was named to head Team B. Teams were selected by lot to emphasize viewpoints not necessarily their own.

Col Lazzell's lineup included Scientific Adviser to the OCRD Director of Developments Harry L. Reed Jr., Dr. Thomas E. Sullivan, Lt Col Orbun F. Qualls Jr., Lt Col J.J. Yeats, Lt Col Harry J. Skinker, Lt Col W.E. Stephens, Lt Col J.E. Fincham, Lt Col Guy E. Jester and R.S. Williamson.

Team B members (negative side) included Lt Cols W.A. Klein, L.S. Lodewick, E.H. Birdseye, C.M. Melia, W.K. Evans, W.Y. Epling, John T. Miller and Maj C.C. McMullin. Members of both teams consisted of a number of chiefs of branches and staff offices.

In leading off for the affirmative side, Col Lazzell quoted from Drake's article: "DoD reform of contracting policy is necessary to prevent cost growth, protect the profit motive, preserve prime contractor commitment, and restore public and congressional confidence in the 'military-industrial' complex (Arsenal for Democracy)."

Drake's recommendations include:

• Follow competitive approach until system definition has in fact been completed, avoiding preliminary Firm-Fixed-Price or Fixed-Price Incentive contracts.

• At conclusion of system definition, in addition to consideration of cost, select winning contractor on basis of his preliminary design, production plans, internal management, past performance, and general capabilities.

• Use parametric estimating techniques to project total costs—that allows for unanticipated costs.

Col Lazzell supported Drake's *Harvard Business Review* article saying:

"Although estimated costs based on item-by-item estimates of initial contract work statements are usually low when compared to actual experience, total program costs *can* be estimated accurately by applying past experience to existing program parameters.

"This proved successful for NASA in estimating the cost of the Apollo (flight to the moon) Program. Realistic costs can be developed in concept formulation by developing and testing prototype components in a competitive atmosphere; therefore, building up the data required for your historical costs.

Other Drake recommendations supported by Col Lazzell's team were:

• Request a breakdown of work package from contractor that includes a total item-by-item cost estimated.

• Estimates must be realistic and based on realistic requirements. Industry has hundreds of specialists to perform actual work although the contractor cannot maintain complete control over estimates and costs. Ap-

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TOTAL DEFENSE EXPENDITURES, CATEGORIZED BY PRICING ARRANGEMENTS

Contract type	Fiscal year 1960	1961	1962	1963	1964	1965	1966	1967	1968
Fixed-price									
FFP	31.4%	31.5%	38.0%	41.5%	46.3%	52.8%	57.5%	56.3%	52.7%
FPI	13.6	11.2	12.0	15.8	18.5	16.6	15.9	17.8	18.7
Other	12.4	15.2	10.8	7.6	6.4	7.1	5.8	4.8	6.2
Cost-reimbursable									
CPFF	36.8	36.6	32.6	20.7	12.0	9.4	9.9	10.4	10.8
CPIF	3.2	3.2	4.1	11.7	14.1	11.2	8.3	8.3	9.0
Other	2.6	2.3	2.6	2.7	2.9	2.6	2.4	2.4	2.6

MAJOR TYPES OF PRICING PROVISIONS USED FOR RESEARCH, DEVELOPMENTAL, TEST AND EVALUATION CONTRACTS OF $10,000 OR MORE

(Amounts in Millions) — Fiscal Year 1969

TYPE OF R D T & E	Total	Firm Fixed Price		Fixed Price Incentive		Cost Plus Incentive Fee		Cost Plus Fixed Fee	
		Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
DEPARTMENT OF DEFENSE									
RESEARCH	$ 283.7	$ 41.1	14.5%	$ 1.8	0.6%	$ .5	0.2%	$ 81.9	28.9%
DEVELOPMENTAL									
Exploratory	614.6	70.7	11.5	7.4	1.2	32.5	5.3	367.1	59.7
Advanced	897.8	116.4	13.0	165.5	18.4	212.4	23.7	381.6	42.5
Engineering	1,553.5	191.8	12.4	231.0	14.9	770.9	49.6	334.9	21.6
Operational System	2,043.0	175.3	8.6	794.9	38.9	842.3	41.2	224.9	11.0
MANAGEMENT AND SUPPORT	617.1	46.7	7.6	59.9	9.7	238.7	38.7	253.6	41.1
TOTAL, R D T & E	6,009.7	642.1	10.7	1,260.6	21.0	2,097.2	34.9	1,644.0	27.4
TOTAL, ALL CONTRACTS	37,185.1	18,652.6	50.2	7,316.8	19.7	3,443.1	9.3	4,677.1	12.6
R D T & E AS A PER CENT OF ALL CONTRACTS	16.2%	3.4%		17.2%		60.9%		35.1%	
ARMY									
RESEARCH	79.6	8.7	10.9	0	0.0	*	0.1	22.8	28.6
DEVELOPMENTAL									
Exploratory	199.5	18.0	9.0	.8	0.4	7.4	3.7	144.0	72.2
Advanced	260.6	34.6	13.3	4.1	1.6	37.0	14.2	178.4	68.4
Engineering	508.1	33.1	6.5	55.2	10.9	336.9	66.3	73.0	14.4
Operational System	127.1	9.9	7.8	2.2	1.8	76.9	60.5	36.7	28.9
MANAGEMENT AND SUPPORT	83.1	9.9	11.9	.5	0.6	19.0	22.9	49.9	60.0
TOTAL, R D T & E	1,258.0	114.1	9.1	62.8	5.0	477.1	37.9	504.8	40.1
TOTAL, ALL CONTRACTS	11,547.4	5,343.0	46.3	1,329.2	11.5	835.4	7.2	2,612.8	22.6
R D T & E AS A PER CENT OF ALL CONTRACTS	10.9%	2.1%		4.7%		57.1%		19.3%	

'Drake Debate' Features Pros, Cons of Procurement

(*Continued from page 8*)

proximately 50 percent are subcontractors.

• Compare total parametric cost and total itemized cost; develop a reasonable and proper mix of performance schedule and cost incentives based on this comparison. This should give us a more realistic cost figure.

• Negotiate a cost-incentive contract for the rest of the engineering development phase. Structure the program with clearly identified milestones, at which incentive awards and cash disbursements for subsequent phases can be made. Emphasis must be placed on accomplishing milestones of achievements in the development phase rather than meeting a predetermined time schedule.

• Base the first-year production contract on costs available at the latest time that allows the contractor to meet the delivery schedule. This would be either a cost-plus-incentive fee or fixed-price-incentive contract.

• Contract for production at the end of engineering development primarily on a fixed-price basis. At this time most of the unknowns will have been identified and solved; therefore, the contract would be more realistic for the contractor and government.

The position of the affirmative team was: "Steps as outlined should allow the contractor to deliver the goods on time, make a profit and maintain good faith with Congress, the Department of Defense and the public by eliminating cost growth in acquisition of advanced weapon systems and technology." As stated by Col Lazzell:

"First, we believe it has been proven to knowledgeable people in the field that total-package procurement (TPP) is not a panacea for the acquisition of major systems. We find unrealistic bidding, even with the risk shifted to the contractor. Many contractors apparently did not believe that the provisions of TPP contracts would be strictly enforced.

"Now we find ourselves with so-called fixed-price contracts which we cannot enforce unless we want to drive several large industries out of business and a large number of people out of work. There may be good reasons for TPP in cases of national emergency, but in most major programs we have charged off in that direction with weak estimates, fixed-price contracts and all. Mr. Drake's approach could avoid this pitfall.

"In the past we have been overly eager to commence production before development is complete. With Mr. Drake's approach, we remain in advanced development until test articles are available, thus reducing the temptation to rush through engineering development and into production.

"In contracts where there are substantial unknowns, even known unknowns, a fixed-price or fixed-price-incentive contract, particularly in contract definition and early development, is not the answer. Yet our policies have us issuing fixed-price contracts at the end of the so-called contract definition to produce integrated packages of items, many of which are partly or wholly unknown quantities.

"We cannot expect a large industry to put its existence on the line at high risks every time it makes a bid. We will soon reach a point similar to that of the State of California in construction of their large dams. All the contractors refuse to bid when they have to assume the majority of the risks. Mr. Drake's approach eliminates this dilemma by not contracting for engineering development until critical review of all systems design.

"The type of contracts used must provide the company a reasonable chance to make a reasonable profit. How the profit should be calculated does not appear to be a fruitful area for our debate, as this is currently covered by our procurement regulations. . . . It is not reasonable to expect a company, no matter how large, to accept all the risk and then limit his profit regardless of how you calculate it.

"We must have competition which is realistic, as to cost, performance and schedule, and competition which is obtained too early in the development cycle will not be realistic competition. As you can see, the contract definition pitfall is avoided in the Drake approach. . . ."

Col Lazzell's presentation for the affirmative side also supported the thesis that use of prototypes and/or breadboards early in the development cycle is necessary. The Army issued directives to this effect in October 1968 and again in June of 1969.

"Many other Drake points are already visible in management constraints of the Department of the Army and the Department of Defense in seeking better visibility into all programs to control cost estimating, program management and improve procurement procedures. . . . We are convinced that principles stated by Mr. Drake are valid. These principles offer a sound solution, meriting Army

Maj Gen Gribble Succeeds Rowny as Deputy CRD

(*Continued from page 1*)

the Southern European Task Force. General Rowny had served since August 1968 as Deputy Chief of Staff, U.S. European Command.

In 1965–66 he was CG, 24th Infantry Division, after serving as Deputy Assistant Chief of Staff for Force Development HQ DA (1963–65) and five months with ACSFOR as special assistant for Tactical Mobility.

General Rowny has served as deputy secretary and then as secretary of the staff, Supreme HQ Allied Powers Europe; Army member, Chairman's Staff Group, U.S. Army Element, Office of the Joint Chiefs of Staff; and as chief, Army Concept Team Vietnam.

Graduated from the United States Military Academy in 1941, he studied at Johns Hopkins University (BS degree in civil engineering, 1937) and Yale University (MA in international relations and MS in civil engineering, both in 1949). He is also a graduate from the Armed Forces Staff College, and the National War College. During his distinguished career as a combat leader and in major staff assignments, he has been honored with numerous citations, decorations and awards.

GENERAL GRIBBLE was graduated from the United States Military Academy in 1941 and earlier attended the Michigan College of Mining and Technology. He is a native of Ironwood, Mich., where he was born May 24, 1917, and has a 1948 MS degree in physical sciences from the University of Chicago.

Before his first assignment as Army Deputy CRD, he was assigned to the Army Materiel Command as Director of Research and Development.

Recognized as one of the Army's top experts in nuclear power sources, he was deputy assistant director, Reactor Development Division, U.S. Atomic Energy Commission from 1953 to 1956. He received the Legion of Merit for developing the Army's first nuclear power plant at Fort Belvoir.

During the construction of the Alaskan Highway, he was regimental supply officer and later a company commander. Then he served in World War II in a succession of engineer assignments in the Pacific Theater, including executive officer of the 340th Engineers during the New Zealand and Luzon campaigns and CO of the 118th Engineer Bn, 43d Infantry Division.

One of his key career assignments was from 1948 to 1952 as a metallurgical engineer with the Los Alamos Scientific Laboratory in New Mexico, which led to his tour of duty with the Atomic Energy Commission.

consideration."

NEGATIVE TEAM PRESENTATION. In presenting the case for the negative team, Lt Col Haumersen disputed the Drake contention that Department of Defense implementation of his recommendation would result in industrial performance within defined costs and defined schedules . . . "thereby restoring public confidence in the 'military-industrial complex.'

"In the first instance, the argument ignores completely the proposition that the system, whatever it might be, must demonstrate a capability to achieve its performance characteristics. Perhaps the intent is to assume achievement of performance characteristics and carry the argument from that point.

"This notion we can dismiss out of hand. This audience needs no recitation of the repeated failures by industry to meet performance requirements for items of equipment. Examples of industrial failure to meet the most rudimentary of contractual agreements are readily available.

"The AIA from which Mr. Drake takes many examples cites four case studies: The C5A aircraft, the air-to-ground missile 1969 (SRAM), MK17 Re-entry Vehicle, and the Titan III. All except the Titan III failed to meet performance specifications. One might consider the Titan III a random success—that is, if we let enough contracts, sooner or later we are bound to have at least one contractor succeed. . . .

"Public and Congressional confidence would appear to us to be much more complex a concept, deriving from such factors as world tension, the pro or antimilitary mood of the popular front, the news media treatment of military news at all levels, and the economic situation.

"We are now and have been for several years in a situation which has been blatantly hostile toward anything military. It is doubtful if a few successful cost-time studies leading to accurate contractual agreements would impact much on such a mood.

"Were the strategic situation to change drastically, we might find a complete reversal of the popular mood —and acceptance of costs which are now decried as 'waste'.

"Secondly, the effect of contracting procedures and method of estimating costs are implied as solutions for cost growth. Yet in the body of his article, Mr. Drake points out that a key factor in cost growth is attributable to the solution of unanticipated unknowns in the development cycle. It is difficult for us to visualize how a contract form or managerial procedure will cause these unanticipated unknowns to become more visible or their solution less costly.

"As a solution, Mr. Drake has proposed substituting a cost-reimbursement contract for a fixed-price contract during development. This appears to be nothing more than subterfuge, implying that if firm estimates are not required cost growth will not occur. Someone—you and I—must still make cost estimates and present them to Congress . . . by which the Congress will judge the cost growth of a project.

"The third remedy expected from a reformed contracting policy is protection of the profit motive and preservation of prime contractor commitment. Profits are reputed to be down to the 3-plus percent level of gross sales on government contracting.

"*The Washington Post*, in a recent by-lined article, reported profits on defense contracts were 12.8 percent, based upon capital investment. This is a more meaningful number, and is the accepted form for computing profits in classical economics. The article also reported that the percentage of defense business of the prime contractors is decreasing.

"We contend that this is the natural tendency of industry to seek expanded markets and is a desirable and healthy condition, benefiting both industry and defense by maintaining production capacities and economic strength in a time of decreasing defense budgets.

"The final point we would like to make is that the data, analysis and conclusions of the Drake article come exclusively from the aerospace industries. Defense procurement is much broader than that and, contrary to Mr. Drake's contention, allows considerable flexibility in the contract types used.

"The article recommends a development model, claiming that the DoD has none. It fails to recognize the viable development model contained in a DA Pamphlet 11-25, 'Life Cycle Management Model,' which provides for the management and review Mr. Drake demands. The Army has been using such techniques as 'Qualified Milestones' and cost-effectiveness analysis in contracting since 1963. At that time, a cost-plus-incentive-fee contract was let to develop the Lance missile.

"The contractor fell behind his Milestone schedule and failed to pick up the first incentive fee. This spurred him to meet following milestones with hardware. The hardware didn't work. Time and again it didn't work.

"Overruns resulted until the whole program had to be stopped and reoriented, and a new contract drawn. We, the Army, have already been where Mr. Drake would have us go, and results were not as he predicts.

"An immediate counter to this example fairly leaps from the pages of Mr. Drake's article—increase top-level management review at critical points and insure that the program tracks; also, that contract procedures for the next phase of development are appropriate. We suggest that these reviews will not solve the real problems, which are identified and solved at the working levels.

"The F111 aircraft project never succeeded in having any of its problems solved—cost overruns, time delays, shortfalls in performance characteristics—although the program was subjected to the most intensive review, on a weekly basis, by the Secretary of Defense, his staff and the Air Force Secretariat and staff.

"We submit that the currently authorized and employed contracting and management procedures are adequate, and that no reform of policy or procedures will correct what appears, time and again, to be shoddy performance by contractors in cost estimation, scheduling and designing engineering."

Conclusion of the presentations, summaries and rebuttals by the teams involved in the debate touched off an extended discussion by members of the audience, including numerous high-ranking officials. Among them were Dr. Wilbur Payne, Deputy Under Secretary of the Army (Operations Research), Dr. D.C. Hardison, scientific adviser to the Combat Developments Command, and Army Chief of Research and Development, Lt Gen A. W. Betts.

The viewpoints focused on the merits of "tight" versus "flexible" contracts, and at what point in prototype development of materiel and in the review and analysis process is a fixed-price contract desirable. The need for a substantially improved interface between R&D supervisors and contractors was generally conceded.

General Rowny, in summarizing some of the high points, cited the experience of General Electric Co. in having to make about 600 product improvements during the research, development, test and evaluation of one weapon system. He suggested that the Drake article may be too narrowly interpreted in many cases and that it is not intended to serve as a panacea for all procurements of advanced weapons systems.

The debate, from the viewpoint of both participants and those in the audience who later expressed their views, was "a good show—one that at least should stimulate continued constructive thinking to deal with an exceedingly complex problem."

24th Power Sources Conference Reviews Government Requirements

U.S. Government Requirements for Power Sources were discussed at an innovative session at the 24th Power Sources Symposium in Atlantic City, N.J., May 19–21, attended by over 800 representatives of military and federal agencies, industry, universities and several foreign nations.

Recent advances were reviewed on primary and secondary batteries, fuel cells, fuze power sources, power processing and thermal energy conversion.

The world's largest annual meeting on power sources research and development activities was sponsored by the U.S. Army Electronics Command, headquartered at Fort Monmouth, N.J., with the support of other agencies. David Linden, acting chief, Power Sources Division, ECOM Electronic Components Laboratory, was symposium chairman.

Cooperating agencies included the U.S. Army Materiel Command, U.S. Army Mobility Equipment Research and Development Center, the U.S. Army's Harry Diamond Laboratories, and the Interagency Advanced Power Group.

Dr. Sidney J. Magram, Physical and Engineering Sciences Division, Office of the Chief of Research and Development, HQ U.S. Army, presided at the first session ever devoted to U.S. Government Requirements for Power Sources. Representatives of seven major agencies contributed to this session.

Lead-off speaker was James E. Griffin, U.S. Department of Defense, who is technical director, Office of the Project Manager for Mobile Electric Power. He was followed by Marshall P. Aiken, staff project engineer, Army Materiel Command.

U.S. Navy speaker was Grenville B. Ellis of the Naval Underwater Weapons Station Laboratory, Newport, R.I., followed by U.S. Air Force representative Wayne S. Bishop, Aerospace Power Division, Wright-Patterson AFB, Ohio. Dr. Fred Schulman, chief, Nuclear Electric Power System, HQ National Aeronautics and Space Administration, detailed NASA requirements.

Edward A. Szczepaniak, professor of aerospace and mechanical engineering at the University of Detroit and a consultant to the U.S. Department of Health, Education and Welfare, discussed HEW power source requirements.

The Department of Transportation's R&D program in power sources was explained by Dr. Richard Strombotne, Office of the Secretary of Transportation.

Featured speaker at the symposium banquet was Dr. Thomas F. Malone, University of Connecticut professor of physics and special consultant to the President on environmental matters. His address focused on opportunities for industrial development offered through advancing technology —progress that now must be considered seriously with respect to any adverse effects that production processes have upon man's environment by pollution of air, water and soil.

Dr. E. J. Casey of the Canadian Defence Research Board chaired a session on Secondary Batteries at which seven papers on electrochemical systems were presented. F. E. Ford and T. J. Hennigan of Goddard Space Flight Center discussed the design of "Nickel-Cadmium Batteries for the Orbiting Astronomical Observatory Spacecraft II." The importance of negative to positive electrode capacity ratio and of negative precharge capacity and their bearing on life of the battery was reviewed.

S. J. Krause of the Jet Propulsion Laboratory (JPL) reported on the selection, design and testing of spacecraft batteries for Mariner Mars 1969. The presentation included flight data from Mariner VI and VII.

E. J. Settembre, Army Electronics Command (ECOM), presented "High-Energy Density, Long-Life Zinc-Silver Oxide Secondary Battery." Four cell monoblocks are used to construct a 9Ah, 24-volt battery assembly with a 100-cycle life.

Dr. Eberhardt Rechtin, right, Principal Deputy Director of Defense Research and Engineering, recently visited the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., for an orientation on electric power sources. Ralph E. Hopkins, chief, Power Technology Division, Electrotechnology Lab, explains features of test rig.

Dr. T. P. Dirkse of Calvin College talked on "Zinc as a Secondary Battery Electrode," discussing poor cycling characteristics resulting from redistribution of zinc (shape change) and the formation of dendrites. Incorporation of additives in the zinc electrode was suggested as the best hope for improving cycle life.

"Physical Changes at Lithium Electrodes During Charge-Discharge Cycling" was by Battelle's D. E. Semones. Differences in density of lithium, lithium chloride and the electrolyte caused nonadherent solid materials either to float or sink in the electrolyte, depending on the orientation of the electrode. Voltage changes could be related to volume changes of the lithium active material during charge and discharge.

J. E. Oxley of Gould Ionics, Inc., spoke of solid-state capacitive devices based on ionic conductors for electrochemical energy storage. These are intermediate between conventional capacitors and secondary batteries with respect to the level and time of power delivery. Fabrication and performance characteristics of a test model were reviewed.

Application of chemical analyses to the components of nickel-cadmium cells to obtain information about performance which supplements charge-discharge data was described. H. H. Kroger of the General Electric Co. reported the method was applied successfully in studies of electrode capacity and state-of-charge after repetitive cycling.

A session on Fuze Power Sources was chaired by Paul E. Landis of the Harry Diamond Laboratories. Presentations described a number of approaches to the design of these one-shot devices, which are required to work on demand, possibly after many years of storage and in severe dynamic environments.

D. M. Smyth of Sprague Electric Co. reported on the properties and chemistry of "Solid Electrolyte Batteries with Modified Silver Iodide Electrolytes," using a silver-tetramethylamonium triiodide. These cells have a flat discharge characteristic and excellent stability over a wide range of temperatures.

"A New High Energy Density Solid Electrolyte Cell With a Lithium Anode" was presented by A. A. Schneider of Catalyst Research Corp. The cell is characterized by high capacity with good voltage in low

drain applications. Performance is not materially affected by extremes of temperature.

Miss E. F. Horsey of Harry Diamond Laboratories explained a new concept for fabricating battery electrodes in "Reserve Electrodes Using Bonded Active Material." Application of a conductive material to reduce interfacial resistance was said to result in efficient lower-cost electrodes.

F. Turrill of Harry Diamond Laboratories (HDL) and W. Kirchberger of Globe Union, Inc., described a low-cost, mass-produced power supply for proximity fuzes. Their paper presented a concept of multiple matrix assembly, with some processes described in detail.

"Reserve Battery Requiring Two Simultaneous Forces for Activation" was discussed by A. M. Biggar of HDL. This reserve battery reportedly is insensitive to rough handling and accidental drop. He reviewed this in his paper.

"The Fluidic Generator: A New Electrical Power Source" was presented by HDL's C. J. Campagnuolo, who explained the manner in which the fluidic generator converts pneumatic energy into electrical energy in a 3-phase transformation: pneumatic to acoustical, acoustical to mechanical, and mechanical to electrical.

Ten technical presentations were made at the primary battery session. Two were concerned with low-temperature batteries, two with batteries containing magnesium anodes, and three with metal-air batteries. Other papers were "Lithium-Nickel Sulfide Batteries," "Semi-Conductor Cathodes for High-Energy Batteries," and "A Heat Sterilizable Remotely Activated Battery." ECOM's A. F. Daniel was the chairman.

W. N. Carson Jr., General Electric Co., presented a paper on design concepts for small mercuric oxide-cadmium cells operable at temperatures down to –60° C. Design factors include electrode composition and fabrication procedures, and amount and kind of electrolyte. Data on polarization, drain rate versus total capacity and utilization of active material at temperatures from +25° C. to —60° C. were presented.

G. W. Fleischmann of P. R. Mallory, Inc., detailed efforts to improve the low-temperature performance of a mercuric oxide-zinc cell. Parameters relative to the efficiency of the system were reviewed and data were presented on the performance of porous electrodes in various electrolyte compositions at different current densities and temperatures.

Field experience with magnesium dry batteries was the subject of a presentation by A. J. Legath of ECOM. The magnesium battery has been giving more than twice the performance available from the conventional zinc-manganese dioxide "dry" battery.

Magnesium batteries also exhibit extremely superior high-temperature storage capability, which makes possible the elimination of the need for refrigerated shipping and storage and enhances field use in tropical or semi-tropical areas.

"Magnesium Anodes Alloyed With Lead and Mercury" was the topic of a paper by R. H. Williams of Sparton Electronics. Alloying with lead and mercury increases by 15–25 percent the voltage of water-activated batteries using magnesium anodes, thus raising power energy outputs. Additional effects are increased solubility in water and greater heat output.

The use of low-cost, nonnoble metal catalysts in zinc-air batteries was discussed in papers authored by H. R. Knapp and J. T. Wynn of ECOM and R. E. Biddick of Gould, Inc.

Information was presented on the cost per cycle of mechanically rechargeable zinc-air batteries using cathodes with precious metal catalysts. Problems are associated with electrodes treated with nonnoble catalysts, though initially they may give performance comparable to platinum-catalyzed cathodes.

R. Jasinski of Tyco Laboratories, Inc., reported on the design and performance of a lithium-nickel sulfide organic electrolyte battery. An energy density of 80 to 100 Wh/lb was cited for nonoptimized batteries discharged in 100 to 1,000 hours.

M. M. Nicholsen of North American Rockwell, Inc., discussed the performance and advantage of semiconductor electrodes in improving discharge rate capability and shelf life. Work was done on n-type cadmium fluoride in lithium perchlorate-propylene carbonate solution. However, the basic concept was said to be equally valid for appropriate electrode materials in aqueous and nonaqueous electrolytes.

Research covering the selection and qualification of the components for a heat-sterilizable remotely activated silver-zinc battery, and the assembly of these components into cells and batteries, was reported by W. van Hartmann of the Jet Propulsion Laboratory, California Institute of Technology.

Presentations in a session on fuel cells, chaired by T. G. Kirkland of the U.S. Army Mobility Equipment R&D Center and J. H. Harrison of the Naval Ships R&D Center, were devoted primarily to the review and discussion of catalysts and electrodes for oxygen reduction; also, to the construction and performance of a variety of fuel cells.

R. A. Fredlein of the University of Pennsylvania discussed the increase in oxygen reduction at bronze-catalyzed cathodes resulting from doping with traces of noble metals and mixing with larger amounts of transition metals (e.g. tantalum, zirconium). Possible reasons for the increased activity are analyzed in the paper; changes and stability of the bronzes are also discussed.

"Sputtered Fuel Cell Electrodes," by J. S. Batzold of ESSO Research and Engineering Corp.. detailed the preparation and performance of electrodes prepared from sputtered plati-

(*Continued on page 14*)

WSO Members of 4 Nations Attend Annual Reception

WASHINGTON STANDARDIZATION OFFICE (WSO) representatives of the United States, United Kingdom, Canadian and Australian (ABCA) Armies attended the recent 21st annual ABCA reception at Fort McNair, Washington, D.C. From right are U.S. Army Chief of R&D Lt Gen and Mrs. A. W. Betts, hosts for the reception; WSO members and wives (from right) are Brig Gen Kenneth F. Dawalt, United States; Brigadier D. J. St. M. Tabor, United Kingdom; Brig Gen E. D. Danby, Canada; Brigadier H. G. Bates, Australia. The Standardization Program was initiated in 1947 to improve allied combat readiness through establishment of common doctrine, items and actions between ABCA nations.

Power Sources Conference Reviews Government Needs

(*Continued from page 13*)

num on various porous substrates. Electrochemical techniques were used to characterize the platinum films.

L. M. Handley of Pratt and Whitney Division of United Aircraft discussed the use of high anodic currents to eliminate carbonate as carbon dioxide from alkaline fuel cells. The paper was titled "Electrolyte Regeneration in Alkaline Fuel Cells," which explained a technique that allows system simplification and operation on untreated ambient air.

"Optimization of Hydrazine-Air Cells" was presented by K. V. Kordesch and M. B. Clark of Union Carbide Corp. High efficiencies are achievable in systems operating with either low- or high-hydrazine levels, provided electrodes of the proper structure are matched to catalytic activity.

J. E. Wynn of ECOM talked about "Methanol-Oxygen Fuel Cells" that use platinum-catalyzed nickel grids, electrically connected to the oxygen cathode, to reduce methanol-oxygen cathode interaction. Hundreds of hours of continuous operation have been attained. In intermittent use, service has been extended to thousands of hours. The system methanol-oxygen gives promise of being a reliable, long-life, low-level power source.

"Hydrogen Generation through Improved Steam Reforming" was reviewed by R. S. Engdahl of Energy Research Corp. The size of reformer selected for evaluation was adequate to supply a 500-watt fuel cell. The major objectives of the investigation included weight and start-up time reductions and the ability to start at temperatures below 0° C.

R. T. Salathe of Whiteley Hydraulics, Inc., presented "Replaceable Hydrazine Module," describing a unit that can be used by itself or in multiple combinations in standardized applications. The design and performance characteristics of the module and system performance parameters were discussed and conclusions were drawn on the current state of development and application.

L. Hymes of Allis-Chalmers Corp. presented a review of current engineering and hardware technology of hydrazine fuel cell systems, utilizing hydrazine concentrations from less than 1 to 18 percent in a range of power outputs (30 watts to 60 kw.)

The air-breathing, matrix-type phosphoric-acid fuel cell was discussed by O. Adlhart of Englehard Minerals and Chemicals Co. in "Studies on the Phosphoric Acid Matrix Cell." He explained the relationship between catalyst requirements, power density and cell life as critical aspects.

R. M. Sayano of TRW, Inc., described results of screening alloys for resistance to corrosion in acid-electrolyte fuel cells.

"The Fuel Cell Power Sources Under Combat Conditions" was reported by F. G. Perkins of U.S. Army Mobility Equipment Research and Development Center. A 300-watt hydrazine-air fuel cell was used in Vietnam combat operations in a variety of applications, as a sole power source or in parallel with more conventional batteries. This experience provided considerable knowledge in design concepts for future activity in development and operation.

D. M. Spadone, Department of the Navy, explained the work being done on the Deep Sea Submergence Vehicle Fuel Cell Power System (DSSV). This will be the main electrical power source for the DSSV and represents one of the major fuel cell programs in the Department of Defense.

In the session on Thermal Energy Conversion, chaired by Col G. D. McPherson, Office of the Chief of R&D, HQ DA. J. P. Angello of the Army Electronics Command discussed "Manpack Thermoelectric Generator."

Two systems were analyzed—a standard line battery charger, in which the thermoelectric device was coupled with a secondary battery to provide start-up power, and a special-purpose generator as a self-contained system for electronic-communication equipment.

These systems, he said, are characterized by quiet operation, long-life, rapid warm-up time and flexibility to meet forward area military operation needs.

"Organic Alkaline Cycle Power System" was the title of a presentation by Max Reck, Sundstrand Aviation Co., who explained the design considerations and system concept along with predicted performance and development status.

General Electric's R. M. Bernero gave a report on SNAP-27, a radioisotype thermoelectric generator system utilizing Plutonium-238 as a thermal energy source. Information on this 70-watt device included key design features, performance capabilities and availability of hardware.

Power Processing was a session organized by Dr. A. G. Bose of the Bose Corp. and chaired by him and W. L. Dudley of USAECOM. The first part of this program highlighted components and various aspects of power processing techniques. Prof. D. H. Navon of the University of Massachusetts gave a paper on "Power Transistor Stability and Reliability," which included trends and estimates of performance that could be expected in the future. E. Reimers of Mobility Equipment Research and Development Center also stressed the component area in his presentation on the use of the heat pipe in Capacitor Energy Storage Improvement.

John Wawzonek, Bose Corp. and E. T. Moore of Wilmore Electronics presented advanced power processing techniques while A. D. Schoenfeld of TRW, Inc. and S. Lindena of Electro-Optical Systems featured design know-how and trade-off criteria on energy storage type processor systems.

Unique specific hardware, processor systems and approaches were viewed at one of two concluding concurrent sessions. Dr. S. Dean Wanlass of Wanlass Electric Co. provided new insight into development progress on "Parametric Transformation of Electric Power." F. C. Yagerhofer of Goddard Space Flight Center described unique aspects of a solar array reorientation system in "Advanced Techniques of Spacecraft Electrical Power Transformation and Control."

In the complex area of high voltage, C. E. Thomas of Chrysler Corp. and R. J. Severns of the Analog Technology Corp. presented papers on specific power supply applications whose requirements stimulated new design approaches.

New design techniques were discussed in the important area of "High Speed Homopolar Alternators," including optimization for static frequency converter supplies and a static solid-state (power processor) motor speed controller for air conditioners (cooling systems).

Conferees indicated the meeting provided an unusual opportunity for an exchange of information in parallel and divergent aspects of power sources technology. An assessment was made of the present status of progress in this very important field and some insight on future trends was established. The benefits derivable from such a meeting are understandably welcomed by the participants and attendees.

Proceedings of the symposium published and distributed by the PSC Publication Committee, P.O. Box 891, Red Bank, N.J. 07701, are expected to be available in October 1970.

EIGHT NEW CONSULTANTS to the Army Scientific Advisory Panel (ASAP) were sworn in at the Spring meeting, May 4–5, at Aberdeen (Md.) Proving Ground. From left are Lt Col Edward E. Roderick, ASAP executive secretary; Dr. Harold M. Agnew, ASAP chairman; Dr. Robert A. Beaudet, associate professor of chemistry, University of Southern California; Dr. Nicholas Yaru, vice president for ground systems, Hughes Aircraft Co.; Kenneth M. Renfro, principal engineer, Lockheed Electronics Co.; Dr. Perry E. Kendall, manager, Missile Guidance and Control, North American Rockwell Corp.; Dr. Felipe J. Montero, staff engineer, ITEK Corp.; Charles W. Ellis, director of engineering, Vertol Division, Boeing Co.; Dr. Russell D. O'Neal, president of Bendix Aerospace Electronics (former Assistant Secretary of the Army, R&D); Dr. R. G. Mererand, research director, United Aircraft.

ASAP Reviews Military Materiel Testing at APG

Army Scientific Advisory Panel members and consultants convened with top-ranking research and development leaders at Aberdeen (Md.) Proving Ground, May 4–5, for a comprehensive briefing and discussion of testing procedures for Army materiel.

Dr. Harold Agnew, ASAP chairman and leader of the Weapons Division at Los Alamos (N. Mex.) Scientific Laboratory, presided at the gathering of 97 panel representatives and research and development dignitaries.

Maj Gen Frank M. Izenour, CG of the U.S. Army Test and Evaluation Command, welcomed the group as host for the meeting. Maj Gen Edward L. Rowny, Deputy Chief of Research and Development, HQ DA, set the theme by emphasizing the importance of testing.

In the initial presentation, General Rowney stressed that maximum effectiveness in testing is a continuing goal because it "consumes significant resources, provides feedback to the developer, trainer and user, and is essential for the decision-maker."

Assistant Secretary of the Air Force for R&D Grant L. Hansen, ASA(R&D) Robert L. Johnson and his deputy Charles L. Poor, Army Materiel Command CG General F. J. Chesarek, Army Chief of R&D Lt Gen Austin W. Betts, Combat Developments Command CG Lt Gen George I. Forsythe and Brig Gen George H. Sylvester, Assistant Director of Defense Research and Engineering (Operational Test and Evaluation), ODDR&E, were among dignitaries.

Charles King, test director of the National Aeronautics and Space Administration's Apollo Project, was guest speaker at a banquet hosted by Army ASA(R&D) R. L. Johnson. After describing in detail the intricate and exhaustive tests that must be conducted on all components and systems of the Apollo Project to insure ultra-reliability, he closed his address with a film on Apollo 13.

Brig Gen Charles D. Y. Ostrom Jr., CG of the Army Ordnance Center and School at Aberdeen Proving Ground, gave a briefing on maintenance engineering and human factors. He pointed up the problems that expanding technology and increasing complex equipment are causing in training programs for maintenance and user personnel.

The introductory briefing on the Test and Evaluation Command was given by Maj Gen Izenour. Other TECOM briefers included Harry A. Bechtol, chief, Artillery Division; Jerry W. Witherspoon, chief, Missile Test Division, U.S. Army Field Artillery Board; Billy D. Sisson, technical director, Armor Materiel Test Directorate; and Benjamin S. Goodwin, chief engineer.

Other briefings relative to the materiel acquisition process and the role of testing were presented on "Life Cycle Testing" by Lt Col Kurt F. Amendi, deputy chief, Test and Evaluation Division, Evaluation Directorate, Army Materiel Command; "Helicopter Development/Quality Testing," Col Delbert L. Bristol, deputy commander for Research, Engineering and Data, Weapons Command; and "Development Testing at the Electronics Command," Director for Laboratories Dr. Robert S. Wiseman.

Representatives from the Army Combat Developments Command described user tests procedures.

General Rowny presented the summary of the meeting and enumerated, in behalf of the Office of the Chief of Research and Development, HQ DA, nine challenges that face the Army in its test and evaluation program:

- Elimination of "non-tests," "non-programs" and duplicative efforts.
- Surfacing problems earlier in the materiel life cycle.
- Increasing emphasis on reliability and maintainability.
- Emphasizing training of people to use and maintain equipment.
- Reducing changes to equipment under development.
- Insuring follow-up on test deficiencies before beginning new tests.
- Specifying realistic confidence levels required in test.
- Supporting and protecting necessary funds for test facilities and instrumentation.
- Insuring that funds are available to continue improvements in testing methodology.

Army Chief of R&D Lt Gen A.W. Betts concluded the spring meeting by soliciting the advice and assistance of the ASAP in addressing the very real problem of making the Army's test and evaluation program more productive and meaningful.

The next ASAP meeting was scheduled Oct. 5–6 at Fort Hood, Tex.

USAARDC Establishes Board To Coordinate R&D Program

Establishment of a board of directors was announced May 6 by the U.S. Army Aberdeen (Md.) Research and Development Center (USAARDC).

The board will assist the USAARDC commander in planning and coordinating the research and development program to make it highly responsive to the requirements of the Army, and more specifically, needs of the Army Materiel Command.

Col Howard C. Metzler, USAARDC commander, said the new board is composed of Dr. Robert Eichelberger, director, Ballistic Research Laboratories; Dr. Joseph Sperrazza, acting director Army Materiel Systems Analysis Agency; Dr. John W. Weisz, director, Human Engineering Laboratories and Harry Ammlung, acting director, Coating and Chemical Lab.

The board has a secretarial and small administrative staff and will meet regularly to conduct its work. Offices at Aberdeen Proving Ground are in Building 328.

Watervliet Arsenal Dedicates $1.7 Million Antipollution Plant

U.S. Army cooperation in the nation's antipollution drive to control disposal of industrial waste was spotlighted at Watervliet (N.Y.) Arsenal May 9 with formal opening of a $1.7 million treatment plant for effluents that have been contaminating the Hudson River.

Federal, state and local officials, along with leaders of industry, business and education, attended the ceremony. Congressmen Daniel E. Button (29th District, N.Y.) and Col William Mulheron, Watervliet Arsenal commanding officer, jointly pulled the switch that activated the plant.

Rep. Button said, in part: "I wish to cite particularly the personnel at the arsenal who, under Col Mulheron, have completed this important installation in the national interest, a role to which Watervliet Arsenal is, in fact, dedicated."

Dwight F. Metzler, deputy commissioner, State of New York Department of Health, commented on the state's progress in pollution abatement: "All of us in environmental health appreciate the contribution of Watervliet to the success of the Pure Water Program."

Edward J. Conley, coordinator, Federal Water Quality Administration, discussed U.S. Government interest in pollution control and Dr. William W. Shuster, chairman of bio-environmental engineering, Rensselaer Polytechnic Institute, spoke on education for pollution control.

Col Mulheron read congratulatory messages from Governor Nelson Rockefeller, Defense Secretary Melvin R. Laird, U.S. Army Materiel Command CG General Ferdinand J. Chesarek, and Lt Gen Frederick Clarke, U.S. Army Chief of Engineers, and Senator Charles E. Goodell.

WATERVLIET ARSENAL CO, Col William Mulheron Jr., and Congressman Daniel E. Button jointly pull the switch to activate a new $1.7 million water pollution control plant for the treatment of Hudson River effluents.

Ceremonies were followed by an inspection tour of the new plant. It provides for the complete treatment of a variety of wastes and the discharge of effluents well within the standards established by state and county health agencies.

Wastes include such materials as hydrochloric, sulfuric, phosphoric, and chromic acids; anodizing and parkerizing solutions; oakite and other cleaning solutions; cyanides and other salts from heat-treating operations; various types of water-soluble and lubricating oils.

Facilities for treatment of industrial wastes are in separate areas and are operated independently of each other. In one area, cyanide wastes, originating from heat-treating operations, are treated. In the other area, the acid-, oil- and metal-bearing wastes are treated.

Waste materials in the second area go into separate collection lines. Acid-, oil- and metal-bearing wastes are transported to separate treatment systems. Since the treatment processes are somewhat interrelated, facilities are collocated in the same building and can treat 35,000 gallons of waste daily.

Quantites and the composition of wastes produced vary widely. Many of the plating, machining and metal-treating processes operate in a "batchwise manner." Some wastes occur intermittently and quantities vary, depending upon levels of production.

The cyanide waste treatment facilities provide for handling salt solutions originating in certain heat-treating operations. Molten salt baths containing cyanides, together with other salts, are used to maintain metal parts at prescribed temperatures for various time periods.

When the metal parts are removed from the bath, a certain amount of salt dragout solidifies on the part and must be removed by washing. This results in a more-or-less dilute cyanide waste stream. Melt pots are washed periodically to produce a concentrated waste stream.

Certain electroplating operations produce dilute rinse wastes, and more concentrated bath wastes when batches are renewed. All cyanide wastes are blended and treated in the same facilities.

Cyanide wastes to be treated are

ARMY LAND LOCOMOTION LABORATORY FOUNDER, Dr. M. G. Bekker, who remained to serve as its first director in 1954, retired June 1 from a 10-year career with General Motors AC Electronics-Defense Research Laboratories. Shown here with scale models of some of his lunar surface vehicle concepts, he is internationally known as the "father" of off-the-road and articulated vehicle concepts for rough terrain of the earth and moon. The American Ordnance Association recently cited him for "many, many contributions to design and ground mobility which have been widely accepted by the Army, the National Aeronautics and Space Administration, and civilian industry." Three of his numerous publications have been acclaimed as "monumental work" in applying systems methodology to off-the-road locomotion problems. They are titled "Theory of Land Locomotion—The Mechanics Vehicle Mobility," "Off-the-Road Locomotion Research and Development in Terramechanics" and Introduction to Terrain-Vehicle Systems." The last was written under contract with the U.S. Army Research Office.

pumped from a collection sump to one of two identical reaction tanks. Wastes are collected in one tank while treatment occurs in the other tank. While wastes are being collected, the tank contents are circulated to ensure mixing. When sufficient waste has accumulated, caustic solution is added continuously from a storage tank to the circulating stream until the pH reaches a level of about 10.

Sodium hypochlorite solution is then pumped from storage to the circulating stream for reaction with the cyanide. The system is put on automatic control and the caustic solution is added at a rate sufficient to maintain a pH of about 9.5. Progress of the rather slow oxidation of cyanide in alkaline hypochlorite solution is monitored and controlled by an ORP controller.

The hypochlorite pump is shut down when the controller senses that the reaction is complete. To ensure complete reaction, however, the batch is circulated for about 30 more minutes. After this time, if the ORP still shows that the reaction is complete, the batch is discharged.

If the reaction is incomplete, more hypochlorite and caustic are added and recirculated until the reaction is completed. While the treatment is proceeding, wastes are accumulated in the other reaction tank for treatment when it is filled.

The many metal-finishing operations at Watervliet Arsenal account for a variety of waste streams since solvents, acids and alkalis are employed. Plating operations also result in the discharge of spent solutions. These are usually highly acid and contain considerable quantities of toxic metal salts.

Acid metal-bearing wastes are collected throughout the arsenal and transported to the treatment plant in a corrosion-resistant sewer line. Wastes of various types are pumped from a collection sump, blended in a holding tank and transferred to a reaction tank where they are thoroughly mixed and recirculated.

Sufficient sulfuric acid is added to maintain a pH of about 3.0. The circulating stream passes through a sulfonator ejector where sulfur dioxide from storage cylinders is blended to react with hexavalent chromium and reduce it to the much less toxic trivalent form of chromium.

Progress of the reduction reaction is monitored by an ORP controller-recorder which senses the endpoint, shuts down the sulfonators and stops the circulating pump. The reduced chromium solution is then transferred to a tank to be blended with solution from treating oil-bearing wastes.

Soda ash solution is added at a rate sufficient to produce and maintain a pH of about 8.0–8.5.

The solution is then transferred to a clarifier where alum solution may be added if desired. The heavy metal ions, after adjustment of the solution to a pH of 8.5, precipitate in the clarifier and are removed from the bottom and transferred to a sludge tank.

Sludge is periodically transferred to drying beds for removal of residual liquid. The clear solution from the clarifier is adjusted to neutrality in a mix-tank and discharged to the sewer.

The oil-bearing wastes originate as coolants and lubricants in the many machining operations at the arsenal. Many of these oils are water-soluble and of vegetable origin. As such, they tend to putrify and must be disposed of periodically. Other oils are only partially soluble and tend to form emulsions with water solutions.

Oil wastes are collected throughout the arsenal and transported to the treatment plant in a separate collection and sewer system. The wastes are pumped from a collection sump to one of two duplicate batch-treatment tanks provided with a bottom sludge scraper and a float skimmer.

Floating oil is skimmed from the top to a collector and run to a skim oil tank. Periodically, the oil from this tank is pumped out to a collection tank truck. Alum solution and a polyelectrolyte solution are added to the treatment tank, and the pH is adjusted to the proper value for optimum flocculation and clarification of the solution through the addition of soda ash or sulfuric acid.

The solution is transferred to a blending tank where the wastes are mixed with the solution from the treatment of the metal-bearing wastes. The combined solution is transferred to the clarifier for development of the alum and heavy-metal precipitates. The combined sludge is transferred to drying beds and the clarified solution after pH adjustment is discharged to the sewer.

A modern control laboratory is used to ensure that proper dosages of treatment chemicals are maintained. In addition, constant surveillance of effluent streams are made to ensure that all standards and public health regulations are met or exceeded.

Aberdeen Enlisted Specialist Typifies Army S&E Program

Illustrative of the high caliber of enlisted scientists in the U.S. Army Science and Engineering Program is Sp/4 Samuel P. Tucker, assigned to the Aberdeen (Md.) Research and Development Center, and author of a recent article in a British scientific journal, *Tetrahedon Letters.*

"Fundamental Studies of Substituted Ferrocene Systems" reports on Tucker's research while studying for his master's degree in chemistry at the Southern Illinois University, Carbondale, Ill. He was awarded a NASA fellowship after earning a BS degree from Virginia Polytechnic Institute at Blacksburg, Va.

Like a substantial number of young Science and Engineering Program participants, Tucker developed his interest in research by competing in high school science fairs. He assembled a transistorized geiger counter while engaged in a physical science project, and won third place in the 12th Annual District Science Congress at Norfolk, Va.

Although classified as a physical science assistant at the Aberdeen R&D Center, where he is assigned to the Coating and Chemical Laboratory (CCL), Tucker is a research chemist in the Automotive Chemicals Branch. He is working to develop a high-temperature, low-hydroscopic brake fluid.

When inducted into the Army, Tucker was scheduled to report to the Nuclear Defense Laboratory at Edgewood Arsenal as a technician in X-ray diffraction, but he was given a choice of transferring to the APG Interior Ballistics Lab or the CCL.

Sp/4 Tucker is a member of three different divisions of the American Chemical Society: Organic Chemistry, Medicinal Chemistry, and Nuclear Chemistry and Technology. Work in which he and two other CCL scientists have been engaged is currently under review for possible publication in *Industrial and Engineering Chemistry.*

Sp/4 Samuel P. Tucker

LT GEN AUSTIN W. BETTS, Army Chief of Research and Development is flanked by Director of Army Research Brig Gen George M. Snead Jr. and Harry L. Levy, JSHS Advisory Council member, at recent Eighth National Junior Science and Humanities Symposium at Univ. of Tennessee.

University of Tennessee Hosts National JSHS

Exemplary representatives of about 5,000 high school students from 25 1969–70 regional competitions participated in the Eighth National Junior Science and Humanities Symposium at the University of Tennessee.

The symposium attracted 147 exceptionally gifted science students and about 100 teachers who provided motivational guidance in local and regional symposia.

Sponsored on behalf of the Army Chief of Research and Development, Lt Gen A. W. Betts, who attended, the symposium was planned and administered by the U.S. Army Research Office, Durham, N.C., and Duke Univ.

Featured attractions included addresses by distinguished leaders of universities, U.S. Government agencies, the American Institute of Archeology, and the Oak Ridge National Laboratory of the U.S. Atomic Energy Commission.

Additional highlights included visits to Oak Ridge Laboratory, the Bull Run steam and generating plant of the Tennessee Valley Authority, the Museum of Atomic Energy, and University of Tennessee research tasks.

The commanding officer of the U.S. Army Research Office-Durham, Lt Col Edgar G. Hickson Jr., presided at the opening session. Dr. Joseph E. Johnson, vice president for Institutional Research, University of Tennessee, gave the welcoming address.

Leon Pomerance, trustee, American Institute of Archeology in New York City, presented a featured opening-session address on "The Final Collapse of Santorini (Thera) 1400 B.C. or 1200 B.C.?" In substantial detail, he cited documented facts to challenge the accuracy of the 1400 B.C. accepted period.

Dr. William G. Pollard, executive director, Oak Ridge Associated Universities, offered an interesting address on "The Uniqueness of the Earth" in respect to its habitation.

"How Does that Grab You" was the topic of Dr. Guy A. Bockman, associate professor of music, University of Tennessee. Following the banquet, over which Army Director of Research Brig Gen George M. Snead Jr. presided, "Men in Space" was discussed by Roy E. Godfrey, manager of the Saturn Program, Marshall Space Flight Center.

Addresses by Dr. J.L. Liverman, associate director, Oak Ridge National Laboratory, on "Energy and the Environment" and Dr. C. P. Keim, the laboratory director of technical information, on "Three Decades of Atomic Energy" highlighted second-day sessions. The afternoon was programed for laboratory visits and a picnic.

Except for an address by Dr. L.M. Branscomb, director, U.S. National Bureau of Standards, on "Science and People," the final day was devoted to discussion groups on environmental and population problems.

Presiding chairmen were Dr. Walter R. Hendon, associate vice chancellor for academic affairs, and Dr. A. Paul Wishart, professor of science education, both on the University of Tennessee faculty.

Moderators for the six concurrent discussion sections were Dr. Gerla Acker, director, Junior Academy, Ohio Academy of Science; Dr. T. Reginald Porter, professor of biology, Sonoma State Colledge, Calif.; Dr. H. Seymour Fowler, professor of science education, Pennsylvania State University; and Dr. John A. Yarbrough, secretary, North Carolina Academy of Science; Dr. Sherwood Githens, professor of science education, Duke University, Durham, N.C.; and Dr. John A. Hoopes, professor of civil engineering, Department of Civil Engineering, University of Wisconsin.

Panel members included Gene B. Welsh, director of regional pollution control, National Air Pollution Administration, Atlanta, Ga.; Robert Shrode, Agricultural Experimental Station, University of Tennessee; William M. Colony, director, Planning and Evaluation Office, Mid Atlantic Region, Federal Water Pollution Control Administration; and

Dr. Alan S. Heilman, assistant professor of botany, University of Tennessee; Lt Col John L. Fletcher, Experimental Psychology Division, U.S. Army Medical Research Laboratory, Fort Knox, Ky.; Dr. Kerry F. Schell, associate professor of forestry, University of Tennessee; and

Philander P. Claxton Jr, special assistant for population matters, U.S. Department of State, Washington, D.C.; Dr. John Stoeckel, associate professor of sociology, University of Tennessee; Dr Gooloo Wunderlick, U.S. Department of Health, Education and Welfare, Washington, D.C.;

Dr. William E. Cole, professor of sociology, University of Tennessee; Mrs. Phillis Piotrow, Population Crisis Committee, Washington, D.C.; and Dr. Gideon W. Fryer, resident director, School of Social Work, University of Tennessee.

Concurrently with the symposium, the Junior Science and Humanities Symposia Advisory Council held a meeting at which Dr. Harry Levy presided in the absence of the chairman, Dr. Ernest Weber.

The Army Research Office-Durham has published a 101-page document listing participants in the Eighth National Junior Science and Humanities Symposium, including abstracts of technical papers upon which student participants were selected from the 25 regional JSH symposia.

A frontis page lists the U.S. Army JSHS Program objectives as:

- To promote the study of the sciences and mathematics, particularly at the high school level; to demonstrate the part which the humanities play in development of the scientist; to emphasize the importance of both the sciences and the humanities to the national culture and general welfare;
- To search out potentially talented youth and to assist in developing their interests and abilities;
- To provide recognition and prestige in the school environment for students who demonstrate an aptitude for, and an appreciation of, the sciences, including mathematics;
- To assist the career-choosing process by revealing the variety of opportunities in the sciences;
- To further efforts to improve the prestige, professional preparation, and recompense of teachers.

3 Special Presentations Made at MERDC Along With Commanding Officer's Awards

Three special presentations were made at ceremonies May 22 honoring winners of the Commanding Officer's Scientific, Technological and Leadership Achievement Awards at the U.S. Army Mobility Equipment R&D Center (MERDC), Fort Belvoir, Va.

Selected from a field of 20 candidates, the achievement winners were awarded a certificate, cash award and a plaque-mounted medal. All nominees received certificates and cash awards through the Army Incentive Awards Program.

Mrs. Walter C. Gelini, widow of the MERDC commander who died suddenly May 17, was presented the original drawing of the "Gelini Medal." Added to the CO awards starting in 1971, the medal will recognize an employe in the administrative and technical services category. Adolph H. Humphreys, designer, presented the drawing of the medal.

Scientific Achievement Award was presented to Maryland D. Kemp, a research chemist, by Dr. Robert B. Dillaway, Deputy for Laboratories, U.S. Army Materiel Command.

Technological Achievement Award went to Dr. Tibor G. Horwath, an Austrian-born physicist. Brig Gen John W. Barnes, Director of Developments, Office of the Chief of Research and Development, made the presentation.

Leadership Award was presented to Albert L. Gaudreault by Lt Col J. E. Baldwin, deputy commanding officer of the center.

Laboratory chiefs Lt Col Philip A. Woolaver, interim chief of Military Technology, and Maj Thomas H. Huber, chief of Advanced Systems Concepts, received special editions of the Leadership Medal. Not eligible for the regular award, they received replicas of the face of the medal, suitably engraved, in recognition of their inspirational leadership. William B. Taylor, MERDC deputy for laboratories/technical director, made the special presentations.

COMMANDING OFFICER AWARD WINNERS for scientific achievement, technological achievement and leadership, are shown with participating dignitaries at 13th annual awards ceremonies at the U.S. Army Mobility Equipment R&D Center, Fort Belvoir, Va. Winners, from left, are Albert A. Gaudreault, Leadership; Maryland D. Kemp, Scientific Achievement; and Dr. Tibor G. Horwath, Technological Achievement. Also pictured are: Front row, right, Lt Col David T. Baker, acting CO of the center. Back row, from left, Lt Col Jess E. Baldwin, deputy CO; William B. Taylor, deputy for laboratories/technical director; Maj Gen William C. Gribble, CG, Fort Belvoir; Brig Gen George M. Bush, CG, U.S. Army Mobility Equipment Command, St. Louis; Brig Gen John W. Barnes, Director of Developments, Office, Chief of R&D.

KEMP, employed in the Intrusion Detection and Sensor Laboratory, was chosen for the Scientific Award over three other nominees based on his significant contributions to knowledge and understanding of the detection of explosives by trace gas methods.

Advanced techniques in the detection of trace gases from concealed explosives, human effluvia, land mines, and clandestine factories. He developed special techniques for absolute purification of explosives and for accurately determining basic data on explosives specifically concerned with volatility and ambient vapor pressures. Data collected are critical to the development of detection devices of major military importance. He also guided the development of an advanced spectroscopic emission detector.

Employed at MERDC since 1957, Kemp holds a BS degree from the Johnson C. Smith University, Charlotte, N.C., where he was a magna cum laude graduate in 1940. He earned a master's degree from Howard University in 1959, and received a Secretary of the Army Research and Study Fellowship for a year at Bristol University, England, 1961–62.

DR. HORWATH, nominated for the Technology Award in 1969, was chosen over six other candidates for the 1970 award based on his advanced acoustic homing technology as well as detailed programing necessary to implement them. His contributions have significant long-range implications to weapons systems for national defense.

Educated at the University of Graz, where he received master's and doctoral degrees in physics in 1963 and 1966, he joined the R&D Center in 1966. He is employed in the Systems Application Division, Advanced Systems Concepts Laboratory.

GUADREAULT, chief of the Photographic Methods and Analysis Branch of the Pictorial Support Division, was chosen over eight other nominees for the Leadership Award. He was cited for outstanding direction of personnel in the performance of highly complex and unprecedented photographic and visual aids support.

Employed at the center since 1946, Gaudreault is a veteran of World War II and has attended the Aero Technical Institute in Los Angeles and the Air Force Photography School.

Brig Gen George M. Bush, CG of the U.S. Army Mobility Equipment Command, was guest speaker.

FLY ME TO THE MOON might be termed the look in Kathy Watkins' eyes as she holds the millionth rocket produced by MBA Associates, timed to coincide with the firm's tenth anniversary. The one-inch diameter, hand-launched, spin-stabilized Gyrojet she's holding was designed to deliver distress signals, such as smoke, flares and radar chaff to altitudes up to 6,000 feet. It can be used by downed aircraft pilots to identify their positions for rescue operations, but also might serve similarly for hunters, hikers, yachtsmen and many others.

Picatinny Adapts Laser for Ignition of Explosives

Adaptation of the laser for remote, wireless initiation of thermal batteries and other devices containing explosives, propellants and pyrotechnics is reported by Picatinny Arsenal, Dover, N.J.

Philip Zirkind, physicist with the Weapons Vulnerability Division, Nuclear Engineering Directorate, has demonstrated the feasibility of using a thin beam of infrared radiation in lieu of a method requiring wires.

The wires, which can act as an antenna to the detriment of the device containing them, have been removed and replaced by a thin transparent window to provide an optical path between the laser beam and the reactive material to be initiated.

Reportedly offering a savings in the cost of thermal batteries and squibs (explosive switches), the method contributes also to increased safety in environments which could cause undesired ignition.

The laser beam, programed to deliver a series of pulses as required, can be directed through the air on a line-of-sight path or through a maze of fiber optics in any direction dictated by the geometry of the equipment used. Upon striking the explosive material, the pulse excites electronic and vibrational energy levels, causing it to ignite.

Objectives of the experimental program were to determine the major parameters affecting the operation of the laser in a confined space, and the characteristics of the reactive mixture.

These included proper heat dissipation within the mixture, and packing the reactive mixture in a container with a transparent window.

In a recent demonstration, a squib with a bridge wire was ignited by a microwave field in contrast with the new squib fired by the laser beam, which was immune to the microwave.

Future efforts will be directed toward miniaturization of the laser and studying the properties of reactive mixtures and fiber optics.

The program was coordinated with Arthur Mittendorf of Unidynamics-Phoenix, Inc. A technical paper describing the laser initiation of thermal batteries is coauthored by Zirking and Mittendorf.

PICATINNY ARSENAL physicist Philip Zirkland (right) checks assembly of laser initiation of thermal battery with Arthur Mittendorf, engineer with Unidynamics-Phoenix, Inc.

APG Statistician Earns Wilcoxon, Youden Awards

"Procedures for Detecting Outlying Observations in Samples," an expository and tutorial paper, recently earned Dr. Frank E. Grubbs both the Frank Wilcoxon and the Jack Youden Prizes for 1969.

One of the Army's foremost statisticians, Dr. Grubbs is currently chief operations research analyst at the U.S. Army Aberdeen Research and Development Center, Aberdeen (Md.) Proving Ground. In 1964 he was honored as the initial winner of the Samuel S. Wilks Award for his distinguished achievements in ballistics research and mathematical statistics.

The Frank Wilcoxon Prize is awarded for the best papers on practical application of statistics published in *Technometrics* during the year. *Technometrics* is published quarterly by the American Society for Quality Control and the American Statistical Association as a journal of statistics for the physical, chemical and engineering sciences.

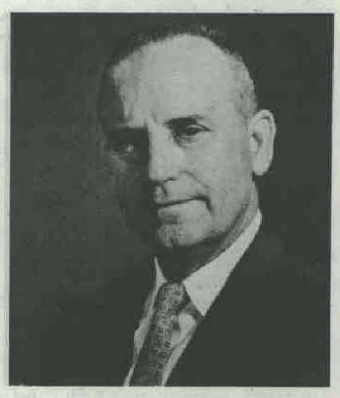
The Wilcoxon prize, which includes a $200 cash award, was awarded also to W. L. Nicholson and K. R. Merck, for "Unfolding Particle Size Distributions."

Sharing honors with Dr. Grubbs for the Jack Youden Prize, awarded for the best expository papers in *Technometrics*, was A. R. Eckler for "A Study of Coverage Problems Associated with Point and Area Targets."

Dr. Gubbs' paper deals with the problem of outlying observations in samples and how to test their statistical significance.

Procedures are detailed for determining statistically whether the highest observation, the lowest observation, the highest and lowest observations, the two highest observations, the two lowest observations, or more of the observations in the sample are statistical outliers.

Both the statistical formulae and the application of the procedures to examples are given to represent a rather complete treatment of tests for outliers in single samples.



Dr. Frank E. Grubbs

OTSG Establishes Office of Patient Care Administration

Discontinuance of the Directives and Policies Branch, Operations Division, Directorate of Plans, Supply and Operations, Office of The Surgeon General, and establishment of an Office of Patient Care Administration was announced May 25.

Col Edward F. Krise, MSC, heads the new office, which encompasses most of the former responsibilites of the discontinued branch as well as expanded functions imposed by implementing a new system of decentralized automation of patient data.

The Health Benefits Branch monitors pertinent legislation and the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS). The Medical Records Branch serves as the hub of the new patient data system. The Patient Administration Branch is the proponent of policies and procedures of patient administration; it also advises the chief of the Medical Service Corps on all matters concerning the Medical Registrar (MOS 2431) career field.

"With the establishment of the Office of Patient Care Administration, Army medical registrars—for the first time—will have an office in OTSG to which to turn directly for guidance in the complex problems that arise in their jobs," said Col L.G.H. Brubaker, MSC, chief, Patient Administration Branch.

This fall a Medical Records and Patient Administration will be used as a vehicle for training registrar teams of the Army Areas, Oversea Areas, and Class II hospitals in the new data reporting system and other changes made by the reorganization.

Similar training for Medical Service Corps officers entering the Patient Administration Course and enlisted personnel participating in the Medical Records and Reports course will begin around September 1970 at the Medical Field Service School.

Budget Cutbacks Compel Termination of THEMIS Research Projects

Project THEMIS will pass into history in FY 1972 as a Department of Defense effort to create "new centers of scientific excellence" in academic institutions capable of addressing national defense needs through Department of Defense funding.

Budgetary cutbacks imposed upon the Army's THEMIS program recently compelled termination of funding support for 16 of 36 ongoing projects and sharply curtailed contracts that were renewed. No new starts are programed, as is true also for the Air Force and Navy sponsorship of THEMIS. Fourteen of the projects terminated had been in progress since 1967.

The Army would have required more than $7 million to continue all ongoing projects at the level planned under a sustained funding policy that was basic to the THEMIS program. Only $2.62 million was available.

Until the budgetary rollback was directed, the total THEMIS program as conducted through the Military Departments was scheduled for FY 1970 expansion to $33 million, under a 3-year plan of sustained funding. This figure was cut to about $9 million.

When THEMIS was launched at the direction of the President in FY 1967, the response of academic institutions desiring to take part in the national expansion of federal support for research in universities produced a total of 479 proposals. The funding level was $20 million and 49 proposals were selected, each with initial-year funding at about $200,000.

The Army sponsored 16 THEMIS projects at 16 institutions in FY 1967 at a cost of more than $6 million, and renewed all, along with 13 new starts at 11 additional academic institutions, in FY 1968. Fifteen of the original 16 contracts were again renewed in FY 1969 and eight more proposals were accepted from six new institutions, raising total cost that year to $9 million.

Army support of THEMIS projects in FY 1971 is anticipated to decrease about 50 percent as compared to FY 1970—to about $1.3 million. One of the rewarding aspects, however, is that, as originally envisioned, some new centers of scientific excellence have advanced to the point where they can engage successfully in open competition for research funds. Six reached this goal in FY 1970.

Numerous other universities were mentioned in a recent Army report as having made notable progress in developing specialized scientific capabilities qualifying them as rising centers of basic research.

For example, the University of Delaware was credited with excellent progress in the field of fluid mechanics, aerodynamics and heat transfer. Stevens Institute of Technology developed new capabilities as a center for cryogenics research.

Similarly, Texas A&M has won acclaim for its THEMIS progress in setting up a center for the prediction of environmental parameters. The University of Kansas was listed for notable gains as a center for remote sensing of the environment.

Oklahoma State University was recognized for gains in descriptions of environmental conditions and weather phenomena; and Louisiana State University for its work as a center for infectious and communicable diseases affecting populations.

Army monitors of THEMIS projects have visited the institutions to make first-hand observations regarding the quality of research being performed and the progress toward the original objectives of the program.

Army THEMIS projects initiated in 1968 and 1969 were renewed as follows: Lehigh University, Non-Linear Wave Propagation; University of Rhode Island, Photoelectronic Imaging Devices; University of Missouri at Columbia, Fluid Transport Properties; Rensselaer Polytechnic Institute, Electrochemical Power Sources and (separate project) Digital Signal Processing; University of Kentucky, Electrochemical Processes; and

University of Cincinnati, Internal Aerodynamics—Heat Transfer; Texas A&M, Aircraft Dynamics for Subsonic Flight; University of Iowa, Vibration and Stability—Vehicles; Virginia Polytechnic Institute, Structural Mechanics of Military Vehicles; Drexel Institute of Technology, Power Metallurgy; Vanderbilt University, Coating Science and Technology; Illinois Institute of Technology, Materials Research; and

Florida State University, Tropical Weather Prediction; University of Missouri, Rock Response to Variable Energy Loads; Rice University, Sensing of Environmental Conditions; North Dakota State University, Control of Vectors; University of Hawaii, Vector-borne Diseases; University of Louisville, Performance Assessment and Enhancement; Texas Technological College, Performance, Recovery and Man-Machine Effectiveness.

Safeguard System Command Names New Chief of Staff

Col Robert J. Bennett has been named chief of staff for the Safeguard System Command, HQ Army Missile Command, Huntsville, Ala., to replace Col J. W. Walters, who will retire from active military duty in July.

Col Bennett has a BS degree from the University of Nebraska and a master's degree from the University of Wisconsin. He is a graduate of the Army Command and General Staff College, and Army War College.

During World War II he served in the European Theatre in four campaigns: Normandy, Northern France, Rhineland and Central Europe.

Among his awards are the Silver Star Medal, Legion of Merit with OLC, Bronze Star Medal with OLC, Air Medal, Purple Heart with OLC, Army Commendation Medal and the Combat Infantry Badge.

Soldier Has 'Stark' Experience

When Army Specialist Bruce Stark arrived in Vietnam from HQ Army Combat Developments Command at Fort Belvoir, Va., his new assignment of quarters was on Belvoir Road. Added to that coincidence was a stranger one. The staff of his new unit had very little trouble learning his name. He replaced a soldier named Bruce Starke.

Picatinny Adapts Commercial Blaster for Army Use

Army engineers at Picatinny Arsenal have redesigned a commercial 11-ounce blasting machine to replace a 4½-pound military device unchanced since World War II.

Produced originally by UMC Industries, Inc., St. Louis, Mo., the device was adapted for Army use by UMC personnel working with Leon J. Frank and Warren Weilbaecher of the arsenal's Ammunition Engineering Directorate at Dover, N.J. The XM32 hand-held unit can fire 10 blasting caps in a 500-foot field wire hookup, and is expected to find broad application in most types of warfare.

WRAIR Tracks Disease Fatal to Army Dogs in Vietnam

Intensive research to diagnose, prevent and control a disease responsible for the death of more than 175 U.S. military dogs in Vietnam within 18 months is making encouraging progress at Walter Reed Army Institute of Research (WRAIR).

Scientists at the Division of Veterinary Medicine have determined that the disease, Tropical Canine Pancytopenia (TCP), is caused by a microorganism transmitted by ticks. The microorganism is related to a group that causes Rocky Mountain spotted fever and scrub typhus.

Unlike these diseases, which are native to the United States, TCP has given no indication that it will infect humans. Researchers have found no evidence of the disease being spread through the air, food, water or animal wastes.

TCP is also called idiopathic hemorrhagic syndrome, canine hemorrhagic fever, and tracker dog disease. The illness has been the most serious health problem affecting the U.S. military dog program in Vietnam.

Characterized by a decrease in number of all the various types of blood cells, TCP was reported in 1963 in Singapore, where it killed many British military dogs. The disease then was considered entirely new and the cause was unknown.

Bleeding was believed at first to be a part of the acute stage of TCP; however, scientists now know that TCP usually starts with a fever. When the fever subsides, the dog regains a normal appearance but remains infected. If blood samples are obtained during this time, the disease usually shows up.

In most instances, acute bleeding and severe blood-cell changes occur weeks after the dog becomes infected. Although the dog with severe nosebleed is easily recognized, TCP can also cause bleeding under the skin or in internal organs. Some dogs have died with no signs of bleeding.

Discoveries made by U.S. Army veterinarians and publication of the results in various medical journals have stimulated veterinarians in other parts of the world to report similar diseases.

Specimens from some of these areas are also being sent to WRAIR, where Army scientists are continuing to learn more in the diagnosis and prevention of the dog-killing disease.

Picatinny Probes Nuclear Detonation Effects on Material

One of the biggest problems in munitions is being studied in Picatinny Arsenal's Nuclear Engineering Directorate by Dr. Paul Harris and Arcadio Garcia, physicists, and Sp/4 Russell Lilliston, who works in engineering mechanics.

The three are probing the shock wave effects in materials which take place when a nuclear missile is detonated. When such a detonation occurs, various types of radiations—neutrons, gamma rays, and the like—will impinge on materials in the vicinity, generating shock waves which can cause structural damage.

As the need arises, they seek additional technical support in Picatinny's Feltman Research Laboratories Engineering Sciences Laboratory. Occasionally, shock wave experiments meant to simulate a nuclear environment are performed at another Army installation or by a contractor.

Shock wave effects studies involve a full understanding of hydrodynamics, solid-state physics and engineering mechanics as well as mathematical analysis and modern high-speed computer techniques. Essential also is a knowledge of the different types of nuclear radiations and how they can interact with various materials.

These men who make up Nuclear Engineering Directorate's Materials Response Group have unusual qualifications. Sp/4 Lilliston has an MA degree from the University of Michigan, has had civilian experience at the David Taylor Model Basin in Washington, D.C., and has expert knowledge of the elastic deformation of shells and membranes.

Garcia's BS degree in physics is from Long Island University and he has graduate credits at two universities. He is a specialist in computer techniques, shock wave computer codes, and nuclear radiation effects.

Dr. Harris, head of the group, has a PhD in physics from the University of Maryland and an MS degree from Rutgers University where he did research in thermomagnetic effects in semiconductors. He has worked in solid-state physics at RCA Labs, Princeton, and in the theory of shock waves in solids at the Naval Ordnance Laboratory, Silver Spring, Md.

Air-Inflated Bridge Envisioned for 20-Ton Tank

Practical capability of an air-inflated bridge strong enough to support a 20-ton tank across a 90-foot span was demonstrated recently under a $50,000 contract with the Army's Mobility Equipment Research and Development Center at Fort Belvoir, Va.

The concept calls for a bridge weighing about 5,000 pounds, transportable in folded-up form on a 2½-ton Army truck. The Goodyear Aerospace Corp. 1/20th scale model, polyester fabric coated with urethane, is comprised of two layers of integrally woven cloth connected by closely-spaced threads.

PROJECT ENGINEER Harry Kifor demonstrates models to show how a 20-ton tank could cross a bridge made of fabric layers inflated with air.

When inflated, the layers expand to the length of the connecting threads and the unit becomes extremely rigid, even at low pressures. If punctured by enemy bullets, this low pressure (15 pounds per square inch) would result in leakage at a level permitting continual resupply with a portable compressor.

When the bridge was needed, the transporter would back to a crossing point and anchor the top pleat of the bridge to the edge of the crossing. The truck then could move away, unfolding the remainder of the bridge. The on-board compressor would inflate the bridge, and a hook and boom, also mounted on the truck, would raise the bridge off the ground.

The truck then would back up, until the bridge reached solid ground on the other side. Engineers believe it would take about 30 minutes to get the bridge unpacked, inflated and in place, and about the same amount of time to repack it aboard the truck.

Joint Laser Safety Team Studies Effects of Radiation on Eyesight

Obtaining biological information essential to field employment of U.S. Army laser devices and systems is a function of the Joint Laser Safety Team created in October 1968, at Frankford Arsenal by the Army Medical R&D Command and the Army Materiel Command.

The Joint AMRDC-AMC Laser Safety Team combines elements of the Medical Research Laboratory at Fort Knox, Ky., and the physical sciences research activities at the AMCs Frankford Arsenal, Philadelphia, Pa.

In its concept of mission, organization and ongoing programs, the team stresses an inter-disciplinary approach to problems of laser safety.

Frankford Arsenal has assembled a team of scientists and technicians with a wide range of expertise for its role. Military and civilian members of its team have advanced training and experience in such diverse fields as applied physics, quantum optics, systems engineering, biophysics, ophthalmology, pathology, laser techniques, and veterinary medicine.

The Joint Laser Safety Team has generated considerable biological data (not yet published) on effects of laser radiation on eyes. During research, development, test and evaluation (RDT&E) phases, a program is under way to evaluate field hazards of a number of laser devices and systems.

Biological investigations are designed to meet the particular requirements and problems of military laser applications. Results of these studies are applied with a view toward the real-life field situation. The program maintains flexibility to react quickly to new developments and directions.

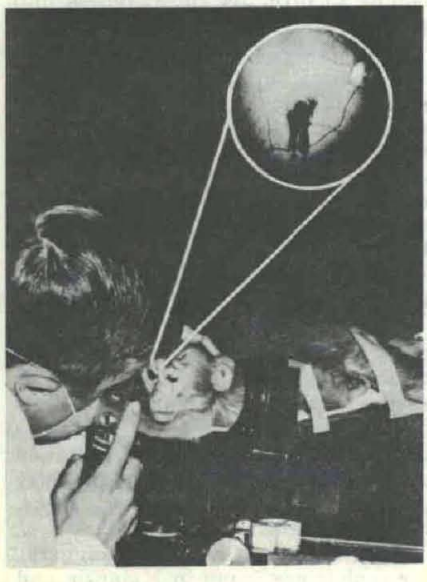


Fig. 1. OPHTHALMOSCOPE is used to examine eye of a rhesus monkey exposed to a high-powered ruby laser. Extensive hemorrhage produced in monkey's retina is shown in inset.

As part of the total program of AMRDC in biological effects of laser radiation, the team has designed and partially completed a series of experiments to establish the threshold energy for eye and skin injury, using a number of different lasers: ruby, neodymium, argon, gallium arsenide, erbium and carbon dioxide.

Eye and skin injury due to suprathreshold exposures will be investigated to determine the pathogenesis and natural cause of lesions produced by high energies.

Studies with erbium, representing the first biological information on this laser system, have demonstrated considerable potential as a relatively "safe laser" for field applications. Three levels of approach in the evaluation of laser-induced ocular injuries are being employed.

First, direct observations are made on rhesus monkeys, utilizing ophthalmoscopic and specialized photographic techniques. Second, tissues of animals exposed to laser radiation are processed for pathological examination by light and electron microscopy to confirm observations on the living animal, to characterize the nature and extent of laser injury, and to elucidate the biological mechanism of laser damage.

In addition, these studies aid in understanding the reparative process in the eye following laser damage. Utilization of these findings hopefully will lead to rational methods of medical treatment for laser injuries.

The Philadelphia area medical community has provided excellent support for the pathological studies by processing tissues and serving as consultants to the Army team. With their assistance, a new technique for preparing retinal tissue has been devised which aids in the rapid survey of the retina for pathological evidence of laser damage.

Third, an attempt is being made to assess the functional effects on vision resulting from laser injury. Among the important questions to answer concerning the effects of lasers on the eye are: What is the immediate incapacitation from a given level of laser irradiation, and what are the long-term visual defects which might ensue?

In an approach to this problem, behavioral studies are being performed on monkeys exposed to lasers in conjunction with the Army Medical Research Laboratory at Fort Knox. After a training period lasting four to six months, the monkeys are able to respond in a predictable fashion to graded visual stimuli (letters on an eye chart). The accuracy with which they can perform these tasks is tested before and after exposure to various lasers.

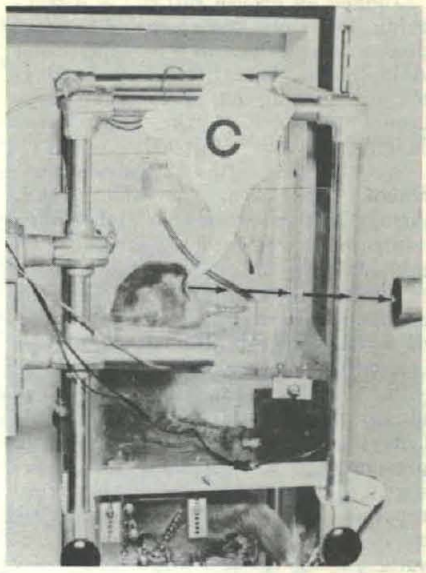


Fig. 2. RHESUS MONKEY, trained to "read" an eye chart, sits in a behavioral apparatus designed to assess effects of laser radiation upon vision.

As a result of this total program of biological research, the Joint Laser Safety Team will provide information to the Office of the Surgeon General regarding thresholds for ocular injury. This information will serve as a guideline for the updating of recommended safe levels of human exposure to laser irradiation.

A program has been established to enable team members to measure the physical parameters of AMC laser items under development to advise the appropriate parties about the safe design, testing and use of these devices.

The team has stressed the importance of identifying the problems of safety at the earliest possible point in the development cycle and applying high technical standards in the performance of parameter measurements.

Efforts are coordinated with other agencies, such as the Army Materiel Systems Analysis Agency (AMSAA), so that the risk of deployment of laser devices can be estimated for a variety of tactical applications.

USAMRU Reports on Tropical Disease Research in Southeast Asia

Judged by proven returns in discovering important knowledge of tropical diseases detrimental to Southeast Asia combat operations, U.S. taxpayers are getting an exceptional value from programs of the U.S. Army Medical Research Unit (Malaysia).

USAMRU is, after 22 years of continuous operation, the oldest U.S. Army medical research laboratory overseas. It was recently acclaimed as a model for suggested establishment of similar units in other critical areas of the world where better knowledge of serious hazards to health of troops is needed.

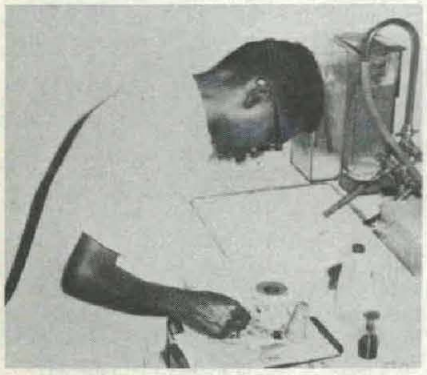
" . . . I feel the Unit exemplifies almost to perfection the best possible type and scope of medical research presence the Army should have overseas," a HQ Department of the Army representative reported after a visit to review USAMRU work and results.

"The laboratory is small," he added, "inexpensive, staffed with outstanding young officers, and very productive. Its productivity is relevant equally to U.S. Army interests and to the public health needs of the host nation and its intermediate neighbors. . . . I have never visited an Army laboratory where I thought we were getting more productivity—both tangible and intangible—per dollar expended than from USAMRU. . . ."

Dr. Allan L. Forbes, MD, chief of the Scientific Analysis Branch, Life Sciences Division, Directorate of Army Research, Office of the Chief of Research and Development, made these comments in a trip report on his visit.

Established in 1948, USAMRU has been served through the years by many staff members with internationally recognized reputations in tropical medicine, medical zoology and ornithology. Among the earliest workers at the laboratory were the late Dr. Joseph Smadel and the then Capt Herbert Ley, who became commissioner of the U.S. Food and Drug Administration under President L. B. Johnson.

U.S. ARMY MEDICAL RESEARCH UNIT occupies upper floor of Institute for Medical Research operated by Malaysian Government in Kuala Lumpur.



USAMRU RESEARCHERS investigate causes of scrub typhus accounting for about 20 percent of fevers of undetermined origin contacted by U.S. troops hospitalized in Vietnam. No vaccine is available for the disease.

USAMRU is considered "ideally located" in Kuala Lumpur, a modern city, with unusually good access to a wide variety of environments, population groups and human tropical infectious disease problems. Within 1½ hours driving time are many different types of country, mountains up to 4,000 feet elevation, mangrove swamps, oil palm and rubber plantations, rice fields, lalang areas (high grass), secondary jungle, primary jungle and true rain forest.

The region is "unequaled for speciation, providing extraordinary availability of insects, arthropod vectors, amphibia, mammals and birds. The opportunities for disease-oriented ecological research are almost limitless. . . ."

Another outstanding advantage to USAMRU researchers is the opportunity to function as a division of the Institute for Medical Research (IMR), operated by the Malaysian Government. This has enabled them to collaborate closely with IMR physicians and scientists and with other government organizations in all parts of Malaysia.

Operated as one of a number of U.S. Army Medical Research and Development Command overseas elements, USAMRU has a primary mission of investigating infectious diseases of potential military importance in tropical Asia.

Commanding Officer Lt Col Francis C. Cadigan Jr. has a staff of six officers, representative of the Medical Service Corps, Veterinary Corps, and Medical Corps, complemented by 60 Malaysians highly trained as technicians and support personnel.

The IMR and its USAMRU component quite often have visiting researchers interested in collaborative effort. Currently, for example, the IMR has one other "foreign" group as part of its structure.

Supported by the U.S. National Institutes of Health, this group of about 10 professionals from the University of California International Center for Research and Training (Hooper Foundation) is interested primarily in research in parasitology, but is hoping to diversify its activities into nutritional, sociological and psychological areas.

Activities of USAMRU include studies of melioidosis, malaria, leptospirosis, infectious diseases of the aborigines, ecology of forest rodents, scrub typhus and certain veterinary diseases such as babesiasis (a parasitic diease). USAMRU is reputed to be one of the "world's most outstanding laboratories for study of scrub typhus."

Currently, when serological studies are performed, scrub typhus is found to account for about 20 percent of the fevers of undetermined origin (FUO) in U.S. troops hospitalized in Vietnam. Thousands of cases annually account for an average loss from duty per man of approximately two weeks. No vaccine is currently available.

Four species of vectors (chiggers) for typhus are found in Malaysia and every conceivable habitat for the vectors is readily accessible for study.

USAMRU researchers believe that for the study of tropical diseases in general, there are few, if any, areas

anywhere in the world where access to such a diversity of causative environments is readily available.

Results of their efforts are described in numerous documents (162 of the most significant papers published by staff members are on a list covering 1948–70), an Annual Progress Report (107 pages for Oct. 1, 1968 to Sept. 30, 1969), and an Army Medical Service Activities Report.

USAMRU's 1948 origin stemmed from an invitation from the Institute for Medical Research, a facility of the Malayan Medical Service of the British Colonial Government, to join in studies of scrub typhus on a temporary basis.

Recognized as a Class II Activity of the Medical Research and Development Command in 1958, USAMRU (Malaysia) was informally established in 1948 by a 5-man team drawn from the Army Medical Service Graduate School—the present-day Walter Reed Army Institute of Research. From 1948 to 1953, the team returned each year for periods of up to six months.

Organizational elements of USAMRU include an administrative section and five departments: Bacteriology, Ecology, Entomology, Veterinary Medicine, and Ricksettial Diseases.

In addition to the intensive effort on malaria and scrub typhus, the USAMRU has directed much attention during the past four years to better understanding of *Pseudomonas pseudomallei* and melioidosis.

A method for the isolation of *P. pseudomallei* from its milieu was developed, using the hamster as a "biological filter." Employing this technique, soil and water from all the peninsular states of West Malaysia and from the state of Sabah in East Malaysia were surveyed for *P. pseudomallei.*

Results of the surveys indicated that:

- *P. pseudomallei* has a wide geographical distribution in Malaysia, being found in all states surveyed.
- The organism can be isolated more readily from cleared land than from virgin forest.
- The chances of isolation of *P. pseudomallei* from the environment, especially surface water, increase after rainy periods.

Both laboratory and field observations seem to indicate that the organism is a normal inhabitant of the environment and does not require a maintenance host such as the rat. Evidence collected indicates that:

- Water samples taken during surveys remained positive for *P. pseudomallei* for more than a year when stored at external ambient air temperature.
- Culturing of the urine, feces, heart blood, lungs, liver, kidneys and spleen of more than 100 wild rats trapped in a highly endemic area of *P. pseudomallei* failed to yield a single isolation.

Serological studies in selected endemic population groups of Malaysia, using a hemaglutination test, have detected significant levels of antibody in from 2 to 19 percent of the people studied.

The serological surveys indicate that although *P. pseudomallei* is widespread throughout Malaysia, the incidence of recognized disease is quite low and inapparent infections with spontaneous cures probably occur.

Further evidence to support this view was gathered when a naturally occurring case of melioidosis in a monkey was observed to subside without treatment.

Little is known about the pathophysiology of melioidosis. Endotoxin and other biological products of *P. pseudomallei* are currently under USAMRU investigation. The goal of this study is to characterize those substances biochemically by gas-liquid chromatography and biologically by assessing their effect on experimental animals.

MALARIA. Recent malaria studies at USAMRU (Malaysia) have consisted of two projects, the first a study of changes in mosquito fauna in a large tract of land under conversion from primary jungle to agricultural land. This work is based on past findings that, as more forested areas are cleared for agriculture or rubber crops, a proportional increase of malaria cases has been observed.

Since half of Malaysia is still covered by primary jungle, and much of this is scheduled for clearing and agricultural development, more detailed information on changes in mosquito population is required. Results of this study should help in the planning of health services for newly opened areas.

In the second study, civilian populations and malaria vectors are being examined in areas where Commonwealth troops were known to have contracted chloroquine-resistant falciparum malaria.

A year ago, after jungle training exercises in several areas of West Malaysia, a number of Commonwealth troops were found to have contracted falciparum malaria which would not respond properly to treatment. Upon close observation, these troops were found to have genuine chloroquine-resistant malaria, mainly of the R1 grade by World Health Organization (WHO) standards.

Working with British Military Hospital personnel in Singapore, USAMRU (Malaysia) has been able to focus its study on several locations where a high incidence of chloroquine-resistant malaria could exist.

Civilians having falciparum malaria within these areas are being treated with the standard dosage of chloroquine and are being observed afterward for possible recurrence of the disease.

Mosquitoes are being collected to determine prevalence of vectors and their parasite carrier rates. An insectary is maintained at the IMR for rearing of important vectors to provide additional information on suspected vector species.

VETERINARY MEDICINE. Since 1961, studies have been conducted on the distribution of leptospirosis in Malaysia and on the relative infectiousness of the surface waters in the forests of Malaysia. In these studies a method of survey of surface waters was developed by using weanling hamsters.

Studies have been conducted on the reservoirs of leptospirosis, and the transmission and the survival of the organism in nature. Most recent studies have been oriented toward studies of leptospirosis in domestic animals, particularly swine and dogs.

Plans call for continuation of studies of the disease in animals, as well as some ecological aspects of leptospirosis in nature, such as the role of natural soils and waters.

Liaison exists between the Department of Veterinary Medicine and the Malaysian Police Dog Unit, the National Zoo, and government and practicing veterinarians. This arrangement provides the Malaysians assist-

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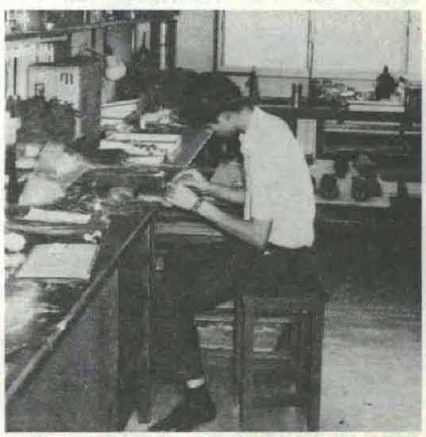


ISOLATION of *Pseudomonas pseudomallei,* using hamsters as a "biological filter," was done at USAMRU.

USAMRU Reports on Tropical Disease Research in Southeast Asia

(*Continued from page 25*)

ance in the diagnosis and control of animal diseases. Concurrently, it provides USAMRU opportunities for investigations of animal tropical and subtropical diseases.

For example, *Babesia gibsoni* infection in dogs was diagnosed for the first time in Malaysia. This led to a study evaluating current drug treatment methods, the results of which indicate that such chemotherapy eliminates the signs of the disease but not the parasite.

The existence of asymptomatic parasitemia can result in the establishment of the disease in new parts of the world, such as the United States, where the vector of the parasite exists. Other unusual diseases that have been detected and reported in the literature are melioidosis infections in monkeys and a camel, chromobacterium infections in gibbons, and pathogenic balantidiasis in a camel.

INFECTIOUS DISEASE AMONG ABORIGINES. West Malaysia (Malayan Peninsula) and East Malaysia (Island of Borneo) offer rather unique opportunities for the study of host-parasite relationships in groups of people who are usually culturally isolated and sometimes geographically isolated.

Previous studies of the aborigines of West Malaysia by USAMRU researchers include the distribution of bacterial enteropathogens in 25 widely scattered communities, documentation of a severe epidemic of whooping cough in which five percent of those affected died, and an investigation of pneumococcal disease in which a significant incidence of pneumococcal meningitis was found.

Intensive studies of patients hospitalized at the Aborigine Medical Center because of bloody dysentery are yielding interesting results. A possible etiologic agent has been isolated from 88 of 100 patients now included in this investigation.

ECOLOGY of arboreal rodents has been investigated at USAMRU. Of prime interest are members of the Peturistinae family of flying squirrels.

Because this study includes determination of viral, bacterial and parasitic enteropathogens, data are being accumulated that will contribute meaningfully to understanding of the interrelationships of these agents in the diseased gastrointestinal tract.

Transfer of multiple resistance to antibiotics from one gram negative bacterium to another by means of conjugation is mediated by a cytoplasmic, extrachromosomal element referred to as R factor. It has been proposed that this plasmid evolved because of the use of antibiotics.

An isolated community of aborigines (Dusuns or Kadazans) that had never been exposed to antibiotics was sought and found in the state of Sabah (East Malaysia). Six strains of *E. coli* isolated from four people were found to possess transferrable, multiple drug resistance mediated by R factors.

Further analysis of these R factors by segregation (deletion) experiments, by curing with acridine orange, and by analyzing their effect on the sex factor (F) of *E. coli* K–12 indicate that some of the bacteria may possess two R factors, an fi+ R factor that inhibits the function of F and an fi-R factor that does not.

ECOLOGY OF FOREST ARBOREAL RODENTS. For more than a year, the ecology of arboreal rodents of the forest has been intensively investigated. Of prime interest is evaluation of the role of members of the *Petauristinae* family, flying squirrels, in the ecosystem. Malaysia, due to its geographical location and faunistic history, is very interesting zoogeographically because its fauna now includes elements from both the Indian, Indo-Chinese and Sunda Subregions.

Understanding of the fauna (including hosts and reservoirs for human diseases) of Malaysia, provides the key to the understanding of faunal relationships of the entire Southeast Asian region. To date over 500 nests, containing over 1,000 specimens of Petauristinae have been examined.

In addition, numerous individuals of Petauristinae, Sciurinae, and Muridae have been trapped and collected by other means. Many new locality records have been established.

Apparent already is that most of the species are highly habitat specific, occupy a certain vertical stratum of the forest, confine their reproduction to a specific season of the year, and have specific dietary requirements. There is evidence of competition between species of similar size and with similar niche requirements.

Several new parasite-host records have been ascertained, including what appears to be a new species of *Plasmodium* from *Petaurista elegans.* A range of new taxonomic characters has been established for Petauristinae. Preliminary data indicate that a new species of arboreal rat has been discovered.

Most of the success of these investigations is attributable to the use of aborigine collectors who are trained to collect nests, other materials, and ecological information in addition to the specimens. The cost per unit of information is low and large quantities of material can be obtained in a relatively short time.

THE RICKETTSIAL DISEASES. USAMRU has been engaged in studies of rickettsial diseases ever since the unit was informally established in 1948. Q fever, murine typhus and tick-borne typhus have been studied from time to time, but chigger-borne (scrub) typhus has been the disease of primary interest.

Efficacy of chloramphenicol in the treatment of scrub typhus and typhoid fever was demonstrated in the unit's first year, in collaboration with physicians of the Institute for Medical Research.

Subsequent field trials of various scrub typhus vaccines in human volunteers failed to show satisfactory protection. A vaccine to protect troops in the field is still not available. Strains of the causative organism, *Rickettsia tsutsugamushi,* are very different immunologically and difficulties have been encountered in attempts to identify an immunologically active antigen common to most, if not all, strains which could be used as the basis for a vaccine. Work on this problem continues at Walter Reed Army Institute of Research.

More recent field studies in Malaysia have concentrated on distribution and behavior of the trombiculid chiggers which transmit the disease to man. Malaysia is a good place to study vector chiggers because in the relatively constant warm humid climate of this country the chiggers are present the year round.

Various types of terrain in which the vector may be expected to occur have been defined, such as lalang grass fields, pockets of secondary for-

est, and along the fringe of sandy beaches.

Considerable effort has been expended recently to define distribution of vector chiggers and situations having special risk of infection for man in primary forest. These field studies have been combined with studies of laboratory-reared colonies of vector chiggers.

The principal interest has been to determine the transovarial passage rate of scrub typhus rickettsiae in vector chiggers. This phenomenon determines to a large extent how many infected larval chiggers are present in a focus of vector chiggers.

One result of these studies has been the development of a colony of vector chiggers in which transovarial passage is virtually 100 percent. For the first time, live known-infected larval chiggers are available for use in a variety of experiments.

The chief application of this tool so far has been to develop an experimental model in primates of naturally transmitted scrub typhus, feeding single larval chiggers on monkeys. This experimental model, it is hoped, will help to characterize immunity to scrub typhus and be of use in evaluation of any future vaccines to protect personnel against this disease.

Opportunities available to USAMRU investigators, particularly in its Department of Ecology, are cited in Dr. Forbes' report of his recent visit to Malaysia, as follows:

"Malaysia is ideal for this type of highly sophisticated work because the nation is the richest in the world for speciation, particularly mammalian and ornithological.

"For example, there are over 500 species of birds in West Malaysia alone, contrasted with all of Africa where only 250 species have been identified . . . many species of primates, flying squirrels, arboreal rats (an entirely new species has recently been identified by USAMRU), and other mammals.

"Facilities for trapping, housing and classifying these animals are good and constantly being improved. A fine museum is being built up in the IMR, and the unit has become a major source of specimens for the Smithsonian Institution.

"They (USAMRU researchers) are making major contributions to the total body of knowledge on tropical animal habitats, vertical distribution, nesting habits, reproductive cycles, blood parasites (including identifying a new malarial species recently), endoparasites, and ectoparasites. . . ."

Edgewood Arsenal Biologist 'Soft-Sells' R&D Careers

Salesmanship for a career in U.S. Government research and development is one of the serendipitous qualities pretty, red-haired, 26-year-old Patricia Moore gives to her job as a biologist at Edgewood (Md.) Arsenal.

Enthusiasm for the opportunities, challenges and benefits of a career as an Army scientist is something Pat acquired quite naturally. Her father is a 30-year retiree from the Social Security Administration.

"Since Dad was with the federal government," she explains, "I was more exposed to the government's research and development programs, in comparison to those of the universities and private companies."

Graduated from Newport News (Va.) High School in 1963 and from William & Mary College in 1967 with a bachelor's degree, she started her career in the Edgewood Research Laboratories in July 1967. Her parents moved from Newport News to an apartment near Pat's when her father retired.

Among the reasons she lists for choosing a government career are:

"There is more money and more rapid advancement at the start in Civil Service. (She started as GS–7 and is now a GS–9 who, according to her branch chief, Dr. Richard G. Horton, has 'learned well the aspects of her job').

"The opportunities to advance are more concrete in the earlier stages of employment. There is a certain amount of financial and definitely more job security. There is more opportunity to do what you want to in the government—you can transfer from one locality to another or from one branch of government to another.

"The educational advantages are clearly defined in the government and there is an opportunity to get financial assistance, if money is available. And even at my present level, I can have small research projects of my own in related fields."

In brief, Pat is "quite satisfied" with her job and highly recommends that other women take a close look at U.S. Government employment.

NO SCREAMS HERE as Pat Moore examines one of the white mice used for research at the Chemical Research Laboratory, Edgewood (Md.) Arsenal.

Callanan Directs NBC Materiel Testing for TECOM

Director of Nuclear, Biological and Chemical Materiel Testing at HQ U.S. Army Test and Evaluation Command (TECOM), Aberdeen (Md.) Proving Ground, is the new assignment of Lt Col John A. Callanan.

Lt Col John A. Callanan

Assigned to the proving ground following tours of duty at Fort Bliss, Tex., and Deseret Test Center, Utah, he served in Southeast Asia as a chemical staff officer with the U.S. Military Assistance Command Vietnam (1966–67).

Commissioned in the Army Chemical Corps in 1949, Col Callanan earned a BS degree at the University of Maryland in 1963 and completed studies at the Command and General Staff College the following year. His military career includes wartime service in Italy and Korea.

His decorations include the Legion of Merit, Bronze Star Medal, Army Commendation Medal with two Oak Leaf Clusters, Vietnamese Hazardous Service Medal, Master Parachutist Badge.

New Strategy for Peace

"A nation needs many qualities, but it needs faith and confidence above all. Skeptics do not build societies; the idealists are the builders. Only societies that believe in themselves can rise to their challenges. Let us not, then, pose a false choice between meeting our responsibilities abroad and meeting the needs of our people at home. We shall meet both or we shall meet neither."—President Nixon at the Air Force Academy, June 4, 1969.

ISF Contestants Stimulate Faith in Talents of Young Generation

CHERRY BLOSSOM award winners, alternates and Tri-Service officers who presented the awards include, from left, Brig Gen Louis Alder, Deputy Chief of Staff for Procurement and Production, HQ U.S. Air Force Systems Command; Air Force alternate winner Virginia Mann (James D. G. Lindsay, the Air Force winner, was out of camera range); Ronald Lee Amey, the Navy winner; Rear Adm Thomas B. Owen, Chief of Naval Research; Bruce C. Marusich, Navy alternate; Debbie Anne Meloy, Army winner; Brig Gen George Sammet Jr., Deputy Chief of Research and Development for Southeast Asia and Director of Plans and Programs, OCRD; and Lance S. Smith, Army alternate.

Detractors of the young generation with any logical appreciation of true "genius at work" were astounded by the fantastic research ability displayed by more than 400 contestants in the 21st International Science Fair in Baltimore, Md., May 10–15.

"Incredible, absolutely incredible!" was a sincere exclamation sounded by many who marveled at displays of research projects exhibited in the huge new Civic Center. In any reasonable skeptic about technological progress of the United States, as entrusted to the budding crop of high school scientists and engineers, the ISF stimulated a refreshing new faith.

Sponsored by Science Service, Inc., a nonprofit organization representative of many of the nation's leading scientific, academic and industrial organizations, with the support of the U.S. Armed Forces, the ISF is the culmination of international competition of more than a million students in 218 affiliated fairs.

Science Service Director Edward G. Sherburne Jr. and Mrs. Dorothy Schriver, assistant director, assisted by officers of the Science Clubs of America, coordinated the administrative arrangements for the ISF. Howard L. Weisbrod was ISF general coordinator.

Under the guidance of Maryland Governor Marvin Mandel, Baltimore Mayor Thomas J. D'Alesandro III and the Honorable Carl F. Benson, MD, as the honorary chairmen, supported by Baltimore educational and business leaders, this year's fair was impressively well-organized and staged. Paul R. Arnold, 21st ISF president, was general chairman.

Many contestants emerged from "The World's Biggest Junior Science Fair" with their scientific careers dependent upon choice of several routes offered to them by organizations bidding for outstanding young talent. Numerous contestants walked off stage as many as four to seven times after receiving various awards.

No better means of appreciating the widespread support given to the ISF is available than a reading of the list of organizations giving awards. Among these are the American Association of Petroleum Geologists; American Astronautical Society; American Chemical Society; American Institute of Mining, Metallurgical and Petroleum Engineers; American Meteorological Society; American Patent Law Association; and

American Pathology-Medical Technology Society; American Phytopathological Society; American Psychological Association; APA Division on the Teaching of Psychology; American Society for Metals; American Society for Microbiology; American Society of Agronomy; Army Aviation Association of America; Entomological Society of America; and

Naval Institute/Marine Technology Society; General Motors Corp.; National Aeronautics and Space Administration; Oceanographer of the Navy; Optical Society of America; Society of Aeronautical Weight Engineers; Society of Photographic Scientists and Engineers; U.S. Department of Agriculture; U.S. Patent Office of the Department of Commerce; U.S. Atomic Energy Commission; U.S. Army; U.S. Air Force; U.S. Navy.

Speakers at the ISF, except for an address by Dr. Glenn T. Seaborg, chairman of the U.S. Atomic Energy Commission, at the awards banquet, were confined to relatively brief remarks as they called winning contestants on stage to receive awards.

Dr. Seaborg, also president of Science Service, briefly traced the near 50-year history of the organization as the "brainchild of the late E.W. Scripps." One of the founders of the Scripps-Howard newspaper chain, he "for years had been concerned about the chasm between actual scientific achievement and the public knowledge and understanding of such achievement . . . scientific news of real importance never reached the public."

"Science Service," Dr. Seaborg said, "has had an impact on the lives of millions of Americans. An educational activity in the broadest sense of the term, it has led to the development first of efforts to improve the public understanding of science and, later, in the organization and encouragement of extracurricular science activities on a wide basis in secondary and elementary schools throughout the U.S.

"Science Service," he said, "has developed through the years a program currently consisting of such activities as Science Clubs of America (with an estimated membership 'of over 400,000 aspiring young scientists'), the International Science Fair, the Westinghouse Science Talent Search, and THINGS of Science." In one way or another, he credited Science Service activities with "impacting on more than 50 million young people."

One of the 21st ISF featured events was the Health Awards Banquet in the Civic Center auditorium, hosted by the American Dental Association, American Medical Association, American Pharmaceutical Association, and American Veterinary Medical Association.

A PANEL OF ARMY JUDGES headed by Dr. J. Fred Oesterling,

deputy scientific director for research at the U.S. Army Natick (Mass.) Laboratories, selected 10 Superior Award winners and 10 Meritorious Award winners on the basis of projects closely related to Army research interests.

The panel also chose Debbie Anne Meloy, 17, a junior at Woodson High School in Fairfax, Va., as its representative and Lance S. Smith, 18, Billerica (Mass.) Memorial H.S., as alternate to the 14th annual Japan Student Science Awards in Tokyo next January.

Navy judges picked Ronald Lee Amey, 17, William Allen H.S., Allentown, Pa., with Bruce C. Marusich, 18, Surrattsville Sr. H.S., Clinton, Md., as alternate. Air Force selectee is James D.G. Lindsay, 17, Los Alamos (N.Mex.) H.S., and the alternate is Virginia A. Mann, 16, Terry Parker Sr. H.S., Jacksonville, Fla.

ISF judges chose two first-place winners ($100 each) in eight categories: applied physics and engineering; biochemistry; botany; chemistry; earth and space science; mathematics and computers, medicine and health; pure physics and zoology. They are:

William Arthur Hendrickson, 17, Wachusett Regional H.S., Holden, Mass., for "Environmental Air Flow." Jeffrey Stephen Braden, 17, Biloxi (Miss.) Sr. H.S., for "The Proton Cyclotron." Jonathan Edward Kern, 17, John F. Kennedy Sr. H.S., New Orleans, La., for "Spectrohelioscope for Solar Research." Robert Curliss Benjamin, 18, Melbourne (Fla.) H.S., "Mechanisms of Genetic Repression."

Also: Oscar Arroyo-Nieves, 16, Superior Corozal (Puerto Rico) H.S., for "Investigation of Atmospheric Fungi of Los Quinteros Cave." Hal Miller, 18, West Holmes H.S., Millersburg, Ohio, for "Raman Effect in Certain Carbon Compounds." John Joseph Schier, 16, St. Louis (Mo.) Priory School, for "The Mechanism of the Catalytic Decomposition of Hypochlorite."

Also: Philip Duane Dicks, 18, Albia (Iowa) Commercial H.S., for "Photosynthetic Gas Exchange System for a Permanent Moon Base." Paul Joseph Steinhardt, 17, Coral Gables (Fla.) H.S., for "Fourth Dimensional Tetraquadric Surfaces and Their Applications." Roy Neil Ferguson, 17, Justin Ford Kimball H.S., Dallas, Tex., for "Discovery: Twenty-first Perfect Number." Cheryl M. Engleman, 18, Hazelton (N.Dak.) H.S., for "Study of Artificial and Natural Antibodies Against IBR Virus."

Also: Andre F. Fountain, 18 Capitol Hill H.S., Oklahoma City, Okla., for "Color Blindness: Its Effect on Man." Luis Antonia Vesquez Camacho, 18, Dr. Gustavo Munoz Diaz H.S., Aguas Buenas, Puerto Rico, for "Bufo marinus as a Vector of *Schistosomo mansoni*."

Also: George A. Zdasiuk, 18, Silverthorn Collegiate, Toronto, Ontario, Canada, for "Plasma Physics." Virginia A. Mann, 16, Terry Parker Sr. H.S., Jacksonville, Fla., for "Comparison of the Photoreceptive Functions of the Parietal and Lateral Types of *Anolis carolinensis*." James S. Moran, 18, St. Louis (Mo.) Priory School, for "Visual Perception in the Pigeon."

BRIG. GEN GEORGE SAMMET Jr., director, Plans and Programs, and deputy chief of Research and Development for Southeast Asia, Office of the Chief of Research and Development, HQ DA, presented awards to winners selected by Army judges.

Superior Award Winners: In addition to Debbie Anne Meloy, each selectee in this category will have a choice of summer employment in an Army laboratory where activities are related to his/her interests. In the event they do not choose either, offers will be made to Meritorious Award selectees.

Debbie Anne Meloy was chosen for a research project titled "Visual and Radio Investigation on the Nature of Jovian Decametric Emissions," a very impressive and ambitious effort.

Other Superior Award winners are: Robert C. Benjamin (listed earlier as an ISF first-place winner); John Martin Ziegler, 18, Greensburg (Ind.) Community H.S.' for "A New Approach to Thyroxine Analogue Synthesis"; Maynard M. Herron, 18, Elkhart (Kans.) H.S., for "Gravimeter"; Jonathan Edward Kern, 17 (listed earlier as ISF first-place winner); Beverly A. Fordham, 17, Bryan Adams H.S., Dallas, Tex., for "Determination of Alpha Vigilance Via Electroence phalography"; and

Bruce Clyde Marusich, 18, Surrattsville Sr. H.S., Clinton, Md., for "*Staphylococcus aureus* Challenge and Hyperbolic Pressure"; Stephen Eric Wade, 17, Moorefield (W.Va.) H.S., for "Function of Man in the Ecology of the Moorefield River"; David H. McDaniel, 18, Washington Irving H.S., Clarksburg, W.Va., for "Control of Chestnut Blight"; and Lance S. Smith (Army Japan Student Science Awards alternate) for "Software to Eliminate Monitor System."

Meritorious Award Winners: John Joseph Schier, 16, St. Louis (Mo.) Priory School, for "The Mechanism of the Catalytic Decomposition of Hypochlorite"; Kip Dopp, 18, Newcastle (Wyo.) H.S., for "Coalescence of Raindroplets"; William Thomas Nachtrab, 17, Lancaster (Pa.) Catholic H.S., for "Equilibrium Analysis of a Metal Alloy System"; Kenneth Charles Brown, 17, R.J. Wasson H.S., Colorado Springs, Colo., for "Strengthening Effects of Particle Reinforcement in Portland Cement and Plaster"; and

Judy Ann Salsbery, 17, Lewis Cass H.S., Walton, Ind., for "Effect of Glucose-Inhibition on the Virulence of *Serratia marcescens*"; Peggy Lynn Spence, 18, Garaway Sr. H.S., Sugarcreek, Ohio, for "Effects of Food Additives and Preservatives on Mice"; Randy Brown, 16. Grand Blanc (Mich.) H.S., for "Effects of Methylcholanthrene on Rats"; William J. Krausmann, 18, Soquel H.S., Santa Cruz, Calif., for "Biochemical Fuel Cells"; Sharon Leah Litteken, 17, Palmyra (Mo.) R–1 H.S., for "Curves of Constant Width"; and Carol D. Vitz, 17, Dallastown (Pa.) Area H.S., for "Predicting Plant Growth Under Simulated Zero Gravity."

BIOGRAPHICAL INFORMATION: Debbie Anne Meloy is the subject of a special article (page 33) as the Army representative selected for the role of a good will emissary to the 14th Japan Student Science Awards in 1971. Biographical information on other Army Superior Award Winners follows:

Ronald Lee Amey became interested in science when 11 years old, after his parents gave him a chemistry set at Christmas. The 21st ISF was his fifth participation in a H.S. science fair, and he has taken a number of scientific field trips in pursuing his interests.

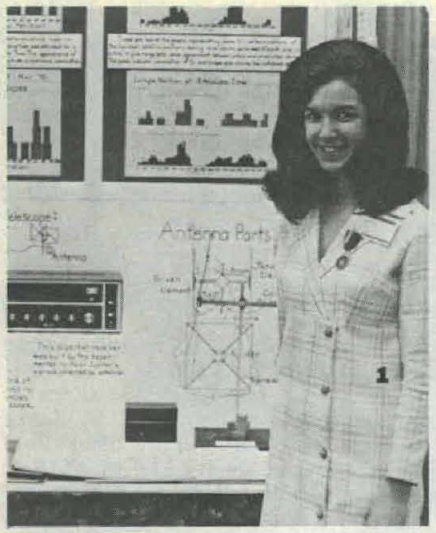
Ronald's father, Carleton R.F. Amey, is an offset lithographic pressman and his mother is a housewife. Dr. W.S. Clewell Jr., Ronald's chemistry teacher, stimulated his interest in research. Ronald is a National Honor Society student and he is active in various clubs, including the Rocket Club and the Science Fair Club.

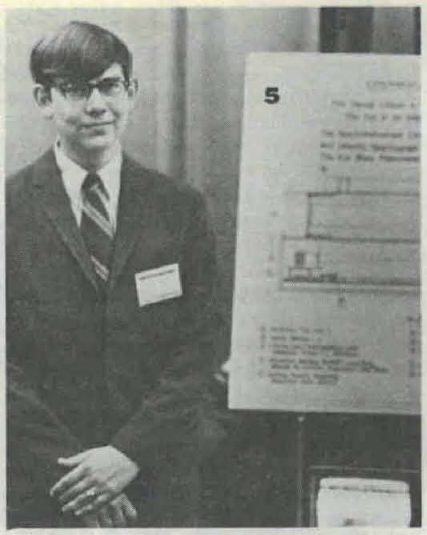
His ISF research project involved collection of Atlantic coast rock barnacles (Balanus) and extraction of the adhesive secreted in their bodies. He has produced an adhesive that is waterproof, exceptionally strong, and is viewed as having possibilities for dentistry and commercial uses, if it can be synthesized.

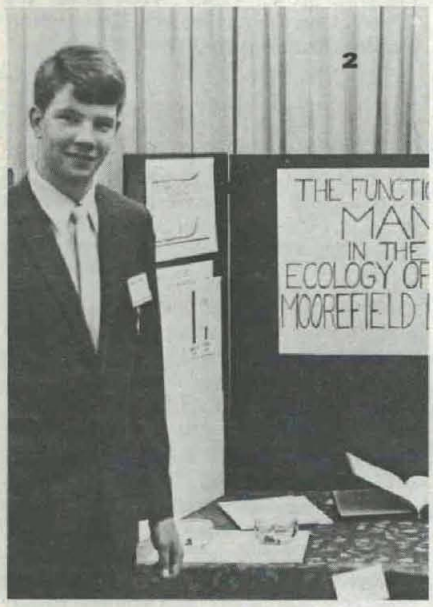
James D.G. Lindsay Jr. is a high school senior and until this year had not reached the finals of the ISF although he entered seven fairs. His interest in science, he says, began at the age of five when he took all his magnets and metals into a bathtub for underwater tests.

Both of his parents have master's degrees in science and his father is

(Continued on page 30)







ISF Contestants Stimulate Faith in 'Now' Generation

(*Continued from page 29*)

employed as a physicist, which helped to stimulate his interest in science. James has plans to become a solid-state physicist and is a member of the National Honor Society, Science Club and Radio Club. His hobbies are scuba diving, pistol competition (NRA), hunting and sailing.

His ISF research project was planned to determine superconducting transition temperatures of niobium-titanium-vanadium alloys, as correlated with Mathias' empirical rules.

Lance S. Smith became interested in chemistry at age 10 but competed in only two science fairs prior to the 21st ISF. His father is an auto salesman and his mother assistant town clerk in Billerica, Mass. Lance attributes his science interest to elementary school chemistry.

Intent on a career in medical computer science and the design of medical machines, Lance finds time to work about a full shift in a supermarket in addition to his research and high school courses. He is a member of H.S. Latin and Computer Science Clubs, Mathematics League, and participates in hockey, tennis and basketball.

His research project resulted in a new type of disk in a data storage system for the computer. He claims it increases the storage area for the user from a normal 58 percent under the IBM Disk Monitor System to a new maximum of 99.9 percent. Termed compatible to the IBM 1130 system, the system developed by Lance is said to "provide the user with maximum data protection for confidential information. . . ."

ARMY ISF Superior Award Winners: (1) Debbie Anne Meloy, (2) Stephen E. Wade, (3) Lance S. Smith, (4) David H. McDaniel, (5) Jonathan E. Kern, (6) John M. Ziegler, (7) Bruce C. Marusich, (8) Maynard M. Herron, (9) Beverly A. Fordham, (10) Robert C. Benjamin.

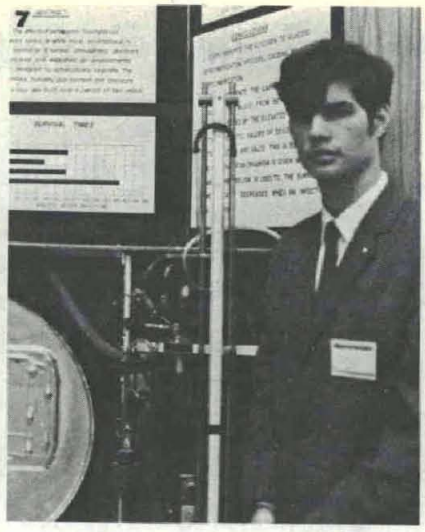
Bruce Marusich did not become interested in science until he was 15, when a school science project started him on the road to competition in four science fairs prior to the 21st ISF. Both of his parents are bus drivers and his mother also operates a dog kennel.

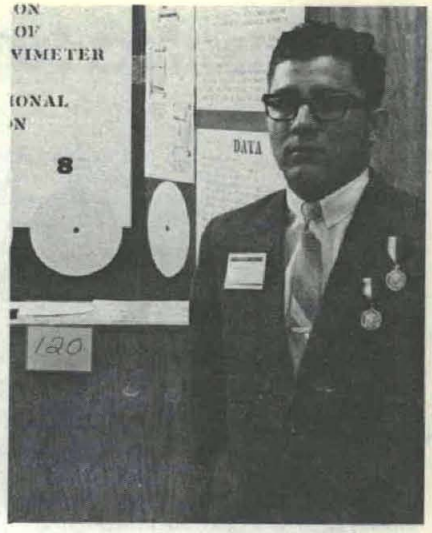
Planning a career in medicine, Bruce has worked as a lab assistant at the Clinton, Md., Community Hospital. He has served as president of the H.S. Science Club and is active in the 4-H, Thespians, Spanish Club, and church.

His research project involved investigations of 16 white mice (divided into groups of eight) to compare results of exposure to normal and lowered atmospheric pressures after infection with *Staphylococcus pyogenes aureus*. It involved measures of blood glucose, liver glycogen, and other conditions after a 30-day acclimatization.

Virginia Anne Mann says she was seven when she started scientific experimentation. The 21st ISF was her sixth competition in a science fair with biological research projects. Her exhibit involved a comparison of photoreceptive functions of two ocular systems through use of the spectrophotometer and electroretinograph to determine neural response complexity and luminosity function of paietal and lateral eyes of *Anolis carolinensis*.

Virginia Anne plans a career in archaeology or electro-physiology. Her father, William W.C. Mann, is an op-





erating superintendent/assistant manager with Sears Roebuck Co. and her mother is a school teacher. Virginia Anne went on a Navy Science Cruise last summer as an ISF winner and attended a number of church conventions. She is a member of church youth groups, science clubs and social studies clubs.

John M. Ziegler reports that his interest was aroused after reading science articles at about age six and that he has been participating in science fairs since he was eight. Last summer he attended the National Science Foundation Institute at the University of Iowa. His interest is organic chemistry or biochemistry.

Dennis A. Wilson Jr., his high school physics and mathematics teacher, is credited with stimulating and providing encouragement to John

(*Continued on page 32*)

Army Panel Selects Outstanding ISF Talent

Judges representative of the numerous organizations making awards at the 21st International Science Fair at Baltimore, Md., May 10–15, had to choose winners from some of the most impressive displays of high school research ever assembled for this event.

An Army panel of judges headed by Dr. J. Fred Oesterling, deputy scientific director for research at the U.S. Army Natick (Mass.) Laboratories, had a particularly rough time trying to select exhibits most closely related to Army in-house laboratory activities—since winners will have a choice of one-week expense-paid visits or summer employment in these labs.

Brig Gen George Sammet Jr., director, Plans and Programs, and deputy chief of Research and Development for Southeast Asia, Office of the Chief of R&D, HQ DA, presented awards to Army winners. The judges included:

Jack B. Fenn, Data Management Division, OCRD, HQ DA, project officer for the ISF; Col Sidney L. Loveless, Reserve Affairs coordinator, College Station, Tex., Dr. Henry P. Kalmus, chief scientists, Harry Diamond Laboratories, Washington, D.C.;

Capt William A. Wells, Plant Sciences Laboratories, Fort Detrick, Md.; Dr. Bruno Papirmeister and Dr. Elmer G. Worthley, Medical Research Laboratory, Edgewood (Md.) Arsenal; John W. Barry, Biological Systems Division, Deseret (Utah) Test Center; and

Lt Col Foster H. Taft, MC, and Lt Col Ramon P. Minx, MSC, U.S. Army Medical R&D Command, Washington, D.C.; Dr. Durwood B. Rowley, U.S. Army Natick Laboratories; Dr. Gordon L. Bushey, deputy chief scientist, U.S. Army Materiel Command; and Harry N. Lowe Jr., Office of the Chief of Engineers, HQ DA.

Reservist officers who served on the panel included Col Jaroslav V. Klima, Huntville, Ala.; Col Albert G. Girod, Saint Davids, Pa.; Maj John M. Taylor, Greenbelt, Md.; Col William L. Surovik, Caldwell, Tex.; Lt Col John V. Perry, College Station, Tex.; Col Edwin M. Vaughan, Bettendorf, Iowa; Lt Col Charles D. Welch, Bryan, Tex.; Capt Ronald D. Stricklett, Salt Lake City, Utah; Capt Salvador L. Camacho, Somers, N.Y.; and Col Roy B. Mefferd Jr., Houston, Tex.

The Reserves were selected on the basis of contributions to the success of junior science fairs on behalf of the Department of the Army as judges and advisers in local fairs.

ISF Contestants Stimulate Faith in Talents of Young Generation

(*Continued from page 31*)

on his research project. John is a member of science, Latin and booster clubs, a choir, plays basketball and golf, and works on the H.S. paper.

His ISF research project involved a study of the thyroid hormone, thyroxine, as a body basal metabolism regulatator and an original approach to synthesis of a new compound, N-acetyl -(3, 5-diiodo-4-hydroxphenyl) glycine.

Maynard Herron started experimenting in science in the seventh grade but the 21st ISF was only his third entry in a science fair. David Camp, a chemistry-physics teacher, encouraged and guided him in the research that led to construction and calibration of a practical gravimeter.

His first effort was a large gravimeter with a variable mass of 45.3592 kg and a spring countering this mass with a force constant of 2.855 x 10^4 n/m. Then he built an instrument "much more practical for several reasons," consisting of a small variable mass and a very weak spring with a force constant of 4.672 x 10^1 n/m, which "proved 84.4% frictionless."

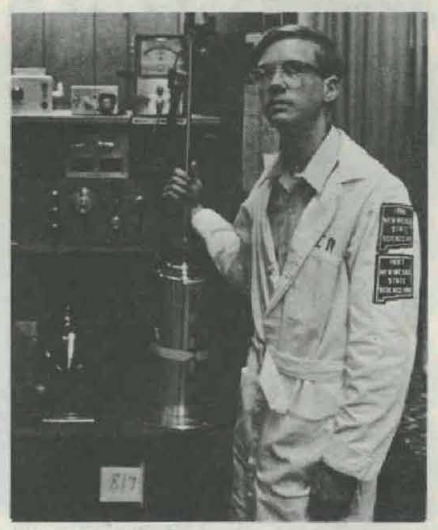
Maynard plans to become an engineer. He has served as president of the H.S. Science Club and is a pianist in church. His father, Charles P. Herron, is a farmer and Maynard helps out with the farm work. Neither parent has a college education.

Jonathan Kern has been interested in science since he was six, at which age he had his first look at organisms through a telescope, but he did not enter science fair competition until 1969. He plans a career in mechanical engineering or astronomy. His father is manager of the Schedule Division, New Orleans Public Service, and his mother is a housewife.

Jonathan's research project involved construction of an experimental spectroheliosсope combining functions of a spectroheliograph and a velocity spectroscope. "An unorthodox instrument incorporating unusual features," it enables observation of solar phenomena, measurement of radial velocities of line-of-sight prominences by Doppler shifting, and detailed analysis of the solar spectrum by photoelectric means.

Beverly Ann Fordham says she has been interested in science "ever since I can remember, due to the wonder of life and parents who encouraged my curiosity." The 21st ISF was her seventh competition in a science fair. She was a 1969 ISF finalist, winning a Navy Science Cruise and a trip to the Army's Aberdeen (Md.) Proving Ground.

Ronald L. Amey
Navy Cherry Blossom Award Winner



James D. G. Lindsay Jr.
Air Force Cherry Blossom Award Winner

Glenn W. Fordham, her father, is an electrical engineer with a BS degree and her mother is a social worker (BA degree of sociology) with the Texas State Department of Public Welfare. Beverly Ann has her sights set on a career in biomedical engineering or medicine. She has participated in ballet, drill teams, drama clubs, science clubs and worked many of her weekends in EEG at Presbyterian Hospital.

Her research project involved the use of a device for monitoring brain waves and those critical changes associated with them in body functions. The instrument, "DAVE," can correlate the electrical activity of the brain with levels of consciousness, and be programed to signal an audible alarm when specific changes occur. She describes her "DAVE" as an "ever-continuing project with unlimited applications and, therefore, an unlimited future!"

Stephen Eric Wade traces his interest in science to age six—"exposure to scientific facts in elementary school began a lasting interest." The 21st ISF was only his third competition in a science fair, but he has plans for a biological sciences career. Steven L. Wilson, a biology and life sciences teacher, stimulated his interest leading to the ISF research project.

Between research tasks, Stephen engages in sales work, football, writing competitions, and Youth Science Camps.

His research project on the "Function of Man in the Ecology of the Moorefield River" involved field investigation in general ecology, analysis of man's function in past and present systems, and projection of acquired knowledge. His conclusion, bearing upon the timely concern with pollution of the life environment, is: "Man's most important function is as a manipulator of environment. The changes continue, and are to some extent predictable."

Robert C. Benjamin, whose scientific interest now is in fossils and archaeological excavations, relates his concern to age seven. He has been competing in science fairs more than six years and was a finalist in the 1969 ISF. His goal is a career as a research biochemist or molecular biologist and he has worked as a summer research class assistant.

Robert is active in the Chess Club, National Honor Society, Debate Club, and National Science Foundation sponsored research activities. His father, Dr. Mason Neal Benjamin, is a retired dentist. His mother also has a BA degree and is a school teacher.

His research project involved a study of the basic genetics of life, resulting in findings that "Actinomycin-D competes with lysinerich histones for binding sites on the DNA molecule, and the presence of either on the DNA can prevent the other molecule from further stabilizing the complex against thermal denaturation."

David H. McDaniel claims he has been interested in science since age seven, and that an older brother sparked his first research activities. Although the 21st ISF was only his third science fair competition, he has

plans for a career in biochemistry.

David is active in numerous high school and other organizations, including the Mathematics Club, Chess Club, Science Club (has served as president), National Honor Society, and Master of the DeMolay in Clarksburg, W.Va.

His research project was concerned with the history, extent and pathogenicity of *Endothia parasitica*, the blight fungus infecting the American chestnut tree, and methods of control. *In vitro* tests to determine effects of an experimental systemic fungicide, duPont 1991, demonstrated that it could be "very effective in inhibiting the growth of the fungus—100% inhibition of mycelial growth was produced at 1991 level greater than 5ppm(active). These levels are well within the commercially and economically feasible range."

Young Scientist Probes Jupiter's Secrets

Results Lead to Army Choice for Trip to Japan

Sometimes, with the soaring uninhibited dreams of youth, a talented girl or boy literally reaches for Jupiter and Mars, creating a private world of the happiness of successfully responding to great challenge, as is true of charming, 17-year-old Debbie Anne Meloy, a Fairfax, Va., beauty.

Debbie Anne will be the U.S. Army's good will emissary, as a young scientist of exceptional ability, to the 14th annual Japan Student Science Awards in Tokyo next January, where she will be accompanied by U.S. Air Force and Navy representatives—two boys equally talented and a Navy WAVE escort officer.

Army judges selected Debbie Anne in the 21st International Science Fair in Baltimore, May 10–15, where more than 400 gifted young scientists representative of more than a million contestants in 218 regional fairs competed for prizes awarded by many of the nation's major scientific, academic, industrial and professional organizations.

Selection was based on her research exhibit titled "A Visual and Radio Investigation Concerning the Nature of Jovian Decametric Emission." The exhibit was good enough to win four other awards, and scientists of several organizations expressed the belief she has a very bright future.

Daughter of Thurston G. Meloy Jr., a Civil Service employe, and Anne E. Meloy, a substitute teacher and housewife, Debbie Anne is a junior at Woodson High School in Fairfax. Her 19-year-old sister Linda is majoring in psychology at the Virginia Polytechnic Institute. They are the only children in the family.

"How did your interest in science begin?" prompted Debbie Anne to reply: "When my parents gave me a 2-inch telescope for Christmas. I was in the second grade at the time, and I became fascinated from then on."

During the nine years since then, Debbie Anne has come a long way toward her goal of becoming an astrophysicist, currently with her sights set on attending Cornell or Princeton University. A U.S. Army astrophysicist who viewed her ISF exhibit and the abstract of her technical paper acclaimed her work as "remarkable."

One paragraph from the abstract serves to convey some understanding of the magnitude of her research:

"Five major divisions of experimentation were involved: (1) the design and construction of an 18 MHz radio telescope; (2) reception and recoding of Jovian noise storms; (3) observation and recording of Galilean satellite positions; (4) longitudinal determinations for actual and predicted emissions; (5) analysis and correlation of collected and predicted data."

Scientific precision is evidenced in records of how long it took her to design and construct the equipment she used, such as 49½ hours to put together a $200 superheterodyne receiver, tape recorder and strip recorder.

She devoted more than six months of virtually all her spare time to grinding and polishing the 6-inch reflector for her telescope, a task requiring a high degree of professional skill. More than a year of effort went into the total telescope.

Construction of a cubical quad antenna, 13.9 feet on each side and 13.9 above ground, was another formidable part of her work, again requiring high standards of precision.

Financing her purchases of equipment also called for strict conservation of her $2.50 weekly allowance from her parents, plus whatever money she could earn by odd jobs. "Mom and Dad," she says, "gave me tremendous moral support all the way."

Mrs. Ruth Opp, her ISF sponsor and chemistry teacher, likewise earned Debbie Anne's deep appreciation but said she never really had to provide much guidance. "Debbie Anne solved her own problems. She came to me as a freshman and said she wanted to prepare a technical paper. When I received it, I was truly amazed. It was as good as many master's theses I've read."

In her ISF project, Debbie Anne devoted nearly every evening over a 5-month period to observing and recording astrophysical phenomena, achieving results that established a correlation between Jovian decametric emissions (recorded from 400 million miles away) and System II longitudes.

Among her conclusions are: No relationship between System 1 longitudes and Jovian noise storms was indicated. Visual observations confirmed the reliability of ephemeris data for satellite positions. Results indicated a relationship between Jovian noise storms and the positions of satellites Io and Europa. There appears to be no correlation between Ganymede and Callisto positions and the decametric emissions.

Debbie Anne has found time to serve as president of her high school science club, president of the Virginia Junior Academy of Science, president of the National Honor Society at Woodson high, and, as of this spring, first baseman or pitcher (alternating) on the softball team.

"That didn't leave you much time for the boys," this interviewer said.

"There's always time for that," she replied with a merry twinkle in her eyes and hint of a giggle. "I even used to play the clarinet, but I had to give that up last year."

Observation: Somewhere along the line she may even find time to enter a beauty contest with such assets as pretty face, sparkling teeth, a captivating smile, long brunette hair and a 117-pound, 5'7½" figure.

Lt Col Peixotto Succeeds Col Brown as WES Director

Lt Col Ernest D. Peixotto became director of the U.S. Army Engineer Waterways Experiment Station (WES) at Vicksburg, Miss., after completing the National War College 1969–70 Course in Washington, D.C.

He succeeded Col Levi A. Brown, director since June 1968, who has been reassigned to duty in Vietnam.

Col Peixotto was earlier assigned to Vicksburg with the office of the District Engineer (1954–55), following tours of duty at Fort Belvoir, Va.; the Panama Canal Zone; and Fort Hood, Tex. He also served a tour of duty in Vietnam as engineer and academic adviser to the Vietnamese National Military Academy.

A 1951 graduate of the U.S. Military Academy, the new WES director also earned a master's degree from the Massachusetts Institute of Technology in 1957. He also is a graduate of the Engineer School at Fort Belvoir, Va., and the Command and General Staff College.

300 Scientists in Phased-Array Antenna Field Attend Symposium

Discussions at a Phased-Array Antenna Symposium involving Armed Forces, academic and industrial scientists were sponsored jointly by the U.S. Army Advanced Ballistic Missile Defense Agency, MIT Lincoln Laboratory and the PIB Electrophysics Department, June 2–5.

First of its kind in six years, the symposium was held at the Polytechnic Institute of Brooklyn (PIB) at the Long Island Graduate Center, Farmingdale, N.Y. It brought together about 300 key scientists in the phased-array antenna field. Discussions summarized the state-of-the-art and significant recent advances.

Arrangements were handled by a steering committee composed of Lindsey B. Anderson and Frank Rouffy of the Advanced Ballistic Missile Defense Agency (ABMDA); Carl Blake and Bliss L. Diamond of Massachusetts Institute of Technology (MIT); George H. Knittel and Arthur A. Oliner, PIB. Arthur A. Oliner of PIB was general chairman, and opened with the keynote remarks.

Featured speakers at the first session were J. A. McCarthy, Bell Telephone Laboratories, Whippany, N.J., whose topic was "Characteristics of Acoustic Arrays and Deep-Ocean Acoustic Propagation, and R. S. McCarter, also with Bell Labs, who discussed "Ballistic Missile Defense Requirements for Phased-Array Radars."

Session II was chaired by Lindsey Anderson and consisted of three well-received presentations: A. C. Schell, Air Force Cambridge Research Laboratories, Bedford, Mass., "Survey of Ground Based Phase-Array Antennas"; M. I. Skolnik, Naval Research Laboratory, Washington, D.C., "Survey of Phase-Array Accomplishments and Requirements for Navy Ships"; and J. F. Rippin Jr., Air Force Avionics Laboratory, Wright-Patterson Air Force Base, Ohio, "Survey of Airborne Phased-Array Antennas."

A. L. Eykholt of ABMDA chaired a session featuring "Phased-Array Antennas for Applications on Spacecraft," by W. H. Kummer, Hughes Aircraft Co., and A. Kampinsky of the NASA/GODDARD Space Flight Center; and "Design, Performance and Cost Considerations for Solid State Arrays," C. Blake, MIT.

Session IV was chaired by P. W. Hannan, Wheeler Laboratories, Smithtown, N.Y., and consisted of four presentations: "Comparision of Array Element Types," L. Stark, Hughes Aircraft Co.; "Methods of Phased Array Analysis," N. Amitay and C. P. Wu, Bell Telephone Labs, Galindo, TRW Systems, Redondo Beach, Calif.; and

"Infinite Arrays of Subarray Antennas," by W. Wasylkiwskj, Institute for Defense Analysis, Washington, D.C.; "Analysis of Infinite Planner Array of Rectangular Waveguides by Generalized Scattering Maxtrix Approach," S. W. Lee, N. Wong and R. Tang, Hughes Aircraft Co.

Special Problems of Radiating Elements was the topic of a session presided over by G. H. Knittel, PIB. Presentations were "Surface-Wave Effects and Blindness in Phased-Array Antennas," A. N. Oliner, PIB; "Edge Effects in Dielectric Covered Phased-Arrays," J. B. Andersen and F. Hass, Technical University of Denmark at Lynogby; "On the Effects of Eliminating Passive Elements from a Thinned Array," G.A. Arredondo, Bell Telephone Labs, and R. L. Knuckey, Western Electric Co.

Design Procedures for Radiating Elements was chaired by L. Stark, Hughes Co., and consisted of three presentations: "Small Arrays—Their Analysis and Use for Design of Array Elements," B. L. Diamond, MIT; "A Survey of the Simulator Technique for Designing a Radiating Element," H. A. Wheeler, Wheeler Labs; and "A New Procedure for the Design of a Waveguide Element for a Phased-Array Antenna," B. L. Diamond, MIT, and G. H. Knittel, PIB.

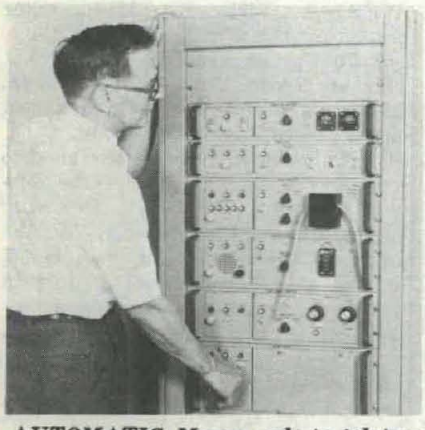
W. L. Patton, Radio Corp. of America, presided at a session on Improved Techniques for Radiating Elements, including presentations by: G. H. Knittel, PIB, "Wide-Angle Impedance Matching of Phased-Array Antennas —A Survey of Theory and Practice"; G. A. Arredondo, P. E. Butzien and R. W. Humes, Bell Telephone Labs, "The Design of a Wide-Band Scan-Angle Waveguide Radiating Element"; and

N. Wong, R. Tang, S. W. Lee and W. R. Jones, Hughes Aircraft Co., "Multimode Phased-Array Element for Wide-Scan Angle Impedance Matching"; E. V. Byron, Johns Hopkins University, Baltimore, Md., "A

Morse Code Converter Demonstrated at AFCEA Meeting

Demonstrated at the Armed Forces Communications and Electronics Association meeting early in June in Washington, D. C., was an automatic Morse code-to-teletype and teletype-to-Morse converter developed under contract with the Army Electronics Command.

Developed by the Electronics Division of General Dynamics Co., the AN/GSA–124 (XE–1) can be installed for use by Special Forces command post or base-level installations to speed message handling and to improve communications with forward units, field forces and mobile or portable radio stations.



AUTOMATIC Morse code-to-teletype and teletype-to-Morse converter has been developed for the Army to improve military communications between command post or base-level stations and forward units or field forces.

First of its type to be built to military specifications, the system accepts machine-sent Morse code at a burst rate of 300 words per minute or hand-sent code at 5 to 30 words per minute over a large range.

In the case of hand-sent messages, it can "track the first" of the operator, adjusting to his speed. The received data is automatically converted to teletype code for local printout or for tape entry into networks.

For transmission, the equipment accepts hand-key Morse code, locally generated teletype tapes or teletype tapes received from a network. Teletype data is converted to Morse code signals and transmitted at selectable speeds from 5 to 30 words per minute to the field operators, or at burst rates of 300 words per minute to Morse code machine copiers.

Transmission and reception can be in either a 2 KHz CW mode or 850 Hz FSK, centered on 2 KHz. The system operates with radio sets presently deployed and those under development. Each half of the duplex system, as well as each individual unit, contains self-testing capabilities.

The major units—detector, Morse-Baudot converter, buffer storage, photoelectric paper-tape reader, converter and modulator—are capable of independent operation.

New Flush-Mounted Antenna Element for Phased-Array Application."

Session VIII, chaired by J. L. Allen, MIT, was devoted to a discussion of Phased-Array Antennas—Manufacturing Problems and Techniques. Panelists: A. M. Briana, Raytheon Co.; J. V. D'Agostino, Sperry Gyroscope Division; B. Dodson, Texas Instrument Co.; P. Hammann, Bell Telephone Labs; R. A. Pickens, Bendix Corp.

Another panel was held on Why Conformal Arrays?, with R.C. Hansen of the KMS Technology Center, Van Nuys, Calif., as chairman. Panelists were G. Chadwick, Radiation Systems, Inc., Alexandria, Va.; J. Provencher, Naval Electronics Laboratory Center, San Diego, Calif.; J. Rippen, Air Force Avionics Laboratory, Wright Patterson AFB; B. Sheleg, Naval Research Laboratory, Washington, D.C.; and J. C. Sureau, Grumman Aerospace Corp.

Leo Schwartzman, Sperry Gyroscope Division and G. D. M. Peeler of Raytheon Co., Bedford, Mass., presided at concurrent sessions on Feeding and Phasing. Presentations were "Phased Array Feed Systems, A Survey," R. T. Hill, Office of the Secretary of the Navy, Washington, D.C.; "Diode and Ferrite Phaser Technology," D. H. Temme, MIT; and "Beam Steering of Planar Phased Arrays," T. C. Cheston, John Hopkins Univ.

"Quantitation and Reflection Lobe Dispersion," G. J. Buck, Hughes Aircraft Co.; "The Step Recovery Diode: An Analog Phase Shifter," J. P. Weir Jr. and R. Kent, Teledyne Ryan Aeronautical Co.; "Time-Scanned Array Radar," G. J. Vogel, B. J. Lyons, K. Parsons and L. W. Bechler, Rome Air Development Center, Griffiss AFB, Rome, N.Y.; and "The Design of Hybrid Multiple Beam Forming Networks," K. H. Hering, TRW Systems Group, Los Angeles, Calif.

C. J. Sletten, Cambridge Labs, and R. T. Hill, Office, Secretary of the Navy, presided at concurrent sessions on Considerations in Design and Evaluation. Presentations were:

"Evaluation of Large Phased-Array Antennas," L. Schwartzman and F. J. Esposito, Sperry Gyroscope Division and C. Blake, MIT; "Limited Scan Arrays," W.T. Patton, RCA; "Pattern Measurement of Phased-Array Antennas by Focusing into the Near Zone," W. E. Scharfman and G. August, Standford Research Institute, Menlo Park, Calif.; "A Method of Locating Defective Elements in Large Phased Arrays," P. L. Ransom and R. Mittra, University of Illinois; and "A Unique Waveguide Phased Array with Independently Steered Beams," D. K. Alexander and B. A. Sichelstiel, Westinghouse Electric Corp.; "A Single-Plane Electronically Scanned Antenna for Airborne Radar Applications," D. J. Lewis, J. R. Lee and D. K. McCarthy, Hughes Aircraft Co.; "Physical Design Considerations for Airborne Electronic Scanning Antennas," M. H. Rosengard, Hughes Aircraft Co.; and "Mechanical Design Considerations of a Phased-Array Antenna," L. T. Embrekts, Sperry Gyroscope Division.

Closing the symposium was a panel discussion on Impact of Solid-State Devices on Array Design, presided over by C. Blake of Lincoln Laboratory, MIT. Panelists were R. J. Bauer, Westinghouse Electric Corp.; E. G. Gaustad, Texas Instrument Corp.; S. D. Gross, RCA; G. Hanley, Sperry Gyroscope Division; M. Johnson, General Electric Corp.; and P. J. Kahrilas, Raytheon Co.

15 Students Complete Engineering Technician Training

Completion of the first engineering technician training program conducted in response to requirements of the Materiel Test Directorate (MTD) at Aberdeen (Md.) Proving Ground was marked by presentation of certificates to 15 college students at the APG in mid-May.

Col James O. Jones, APG commander, presented the certificates and congratulated the graduates on completing 30 months of arduous training at the APG. He emphasized that the MTD requirements for engineering technicians could not be satisfied by recruitment. The need for a training program became evident in 1967.

With the cooperation of officials of Harford Junior College, arrangements were made for a comprehensive training program embracing 12 subjects of broad scope. All courses were held at the Proving Ground, utilizing MTD facilities.

The program marked the first time that the APG had worked jointly with a college to satisfy a need specifically tailored to proving ground requirements:

Rigorous and demanding, the training program initially attracted 25 students, only 15 of whom became graduates. Twelve are students at Harford Junior College, Towson State College and the Univ. of Delaware.

Participants in the ceremony included Col Paul A. Troup Jr., MTD director, who assisted in presenting the certificates; Dr. Joseph N. Hankin, president, Harford Junior College; R.D. Witt, MTD associate director; R.W. Johnson, chief, MTD Technical Support Division.

Aberdeen PG Initiates Executive Development Program

Students comprising a section of "Who's Who" among leaders of agencies at the U.S. Army Aberdeen (Md.) Proving Ground participated recently in the initial class of an Executive Development Program.

The 2½-month course, 1½ to 2 hours a week, was developed under the direction of Mrs. Kay L. Adams and her assistant, John S. Houser, employe development specialists in the Civilian Personnel Division.

A tentative structure permitted the reactions and proposals of the students to guide the direction of study and flow of discussion. Students read assigned or other books to prepare for the discussions. Five film case-studies were explored in class.

Students included Col Rudolph A. Axelson, commander of the U.S. Army Land Warfare Laboratory, and Col Walter E. Rafert, commander of the U.S. Army Small Arms Systems Agency.

Other leaders or key personnel in the course were Col Donald H. Greeley, U.S. Army Combat Developments Command Maintenance Agency; Col Paul A. Troup Jr. and Richard P. Witt, Materiel Test Directorate, Test and Evaluation Command; C. Y. Best, Joint Military Packaging Training Center; and

Benjamin S. Goodwin, Test and Evaluation Command; Col William D. Meara, HQ Aberdeen Proving Ground; Col George C. Santos, Kirk Army Hospital; Dr. Russell D. Shelton, Land Warfare Laboratory; and Charles R. Winchell, Army Ordnance Center and School.

Maj Gens Foster, Rienzi Switch Assignments With STRATCOM

Maj Gens Hugh F. Foster Jr. and Thomas Matthew Rienzi will switch key assignments in June and July with the U.S. Army Strategic Communications Command in the Pacific and Southeast Asia.

General Foster is CG of STRATCOM Pacific and deputy chief of staff, Communications-Electronics U.S. Army Pacific. He will leave June 20 to succeed General Rienzi as CG, 1st Signal Brigade in SEA.

The brigade is the largest combat signal unit in U.S. Army history, with over 200 communications sites manned by 20,000 personnel—five signal groups in Vietnam and one in Thailand.

General Rienzi is scheduled to take over the dual responsibilities of CG of STRATCOM Pacific and chief of staff, USARPAC July 20.

Col Hyman Commands CDC Institute of Land Combat

Command of the Institute of Land Combat, a Combat Developments Command organization at Fort Belvoir, Va., was assumed June 8 by Col (Brig Gen designate) Arthur S. Hyman, a 26-year Army veteran previously assigned as command assistant for Project Appraisal.

Maj Gen O. A. Leahy vacated the job to become chief of staff, Sixth Army, Presidio of San Francisco, Calif. Col Hyman, 50, joined HQ CDC less than two years ago as chief, Organization and Evaluation Division, Combat Support Group, and five months later became director of CDC Organization.

In November, 1969, he was assigned to his present position for determining objectives and priorities in the combat developments field.

The Institute of Land Combat is responsible for forecasting likely future trends in the world environment —identifying military threats up to the year 1990 and cataloguing and describing possible options to guide combat developments efforts. It also serves as a unifying force for all developmental actions to insure complete and continuous interface with agencies engaged in long-range development of materiel.

Col Hyman was graduated in June, 1944, from the United States Military Academy at West Point, N.Y. During World War II he served with the 511th Parachute Regiment, 11th Airborne Division, and participated in the campaign of Leyte and Luzon, Philippine Islands. After graduating from the Command and General Staff College, Fort Leavenworth, Kans., he

Col Arthur S. Hyman

was assigned as G3 Plans Officer, XVIII Airborne Corps, Fort Bragg, N.C., and in 1955–56 was aide-de-camp to the commanding general, Sixth U.S. Army, Presidio of San Francisco, Calif.

In 1958 he attended the Armed Forces Staff College, Norfolk, Va., and then went to the Airborne Electronics Test Board at Fort Bragg, N.C. Four years later, while attending the Army War College, Carlisle Barracks, Pa., he was awarded an MA degree in international affairs from George Washington University.

Army, NASA Test Shuttlecraft Model at WSMR

Shuttle trips between the earth and an orbiting space platform are progressing toward reality through tests of a scale-model shuttlecraft that successfully completed May 27 the first in a series of drop tests at White Sands (N. Mex.) Missile Range.

Designated "Manned Spacecraft Center 12.5K Space Orbiter Shuttlecraft," the dynamically scaled model is one-tenth the size of the Space Orbiter Shuttlecraft being developed by the National Aeronautics and Space Administration for use in the 1970s.

The 600-pound vehicle was dropped from a U.S. Army CH–54 Sky Crane helicopter flying at 12,000 feet above sea level. The model is 13 feet long and 2 feet in diameter, with an 8-foot wing span. During its descent, the vehicle was controlled from a NASA van located in the drop zone.

Manned Spacecraft Center engineers, headed by Royce L. McKinney, said the WSMR tests are designed to demonstrate the vehicle's transition from a steep reentry angle to a level cruise attitude and its stability in stalled conditions.

The team hopes to complete the series of experiments within 90 days. Free-flight data will be obtained to assist the designers in predicting aerodynamic behavior and in analyzing transition techniques.

Several systems are incorporated within the vehicle for instrumentation, control and recovery. Included are a telemetry system, a dual command system, a cold-gas rate-damping reaction control system, a controllable elevator system, a forward-looking movie camera, a radar transponder, stabilization parachutes, recovery parachutes and a safety timer sequencer system.

The scale-model vehicle incorporates a fiberglass fuselage, breakaway fiberglass wing tips and a fiberglass vertical stabilizer. All can be changed easily if damaged or to update configuration of the model.

The experimental vehicle lands in a nose-down attitude when suspended from its parachute, and has a crushable nose section to attenuate landing shock. Other parts are aluminum.

Employes of the NASA Manned Space Center Landing and Recovery Division, assisted by personnel of NASA's White Sands Test Facility, comprise the test team. Arthur L. Sponagel is the Army project engineer and George M. Ortiz is NASA test conductor.

SHUTTLECRAFT MODEL, suspended underneath a U.S. Army CH–54 helicopter, was dropped from 12,000 feet during recent drop tests at WSMR.

Cotter Takes ARPA Position As Director of Overseas DRO

Director of the Advanced Research Project Agency (ARPA) Overseas Defense Research Office (Project Agile) is the new title of Donald R. Cotter, recent successor to Seymour J. Deitchman, who has returned to the Institute for Defense Analysis.

Cotter was recently director of Systems Planning for Sandia Laboratories, Albuquerque, N. Mex., and assistant to the president, Sandia Corp. Prior to this dual role, he was Special Assistant for Southeast Asia Matters, Office of the Director of Defense Research and Engineering (ODDR&E).

He has served as Special Assistant for Counterinsurgency in the Tactical Warfare Office, ODDR&E; director, Advanced Systems Research, and then manager of the Systems Engineering Department, Sandia Laboratories; and production development engineer with Philco Corp.

Cotton has performed as a consultant to a number of U.S. Government organizations, including ODDR&E, the U.S. Atomic Energy Commission, and committees of the Congress. On July 11, 1968, he was awarded the Secretary of Defense Meritorious Civilian Service Medal for contributions to military technology in the Southeast Asia conflict.

While attending Lehigh University and the University of New Mexico, he majored in industrial and electrical engineering, mathematics and physics.

Lt Col Arnold Assigned as USAERG Director

Director of the U.S. Army Engineer Reactors Group (USAERG), Fort Belvoir, Va., is the new title of Lt Col Harvey L. Arnold Jr., who returned recently from duty in South Vietnam.

As successor to Col Robert L. Ednie, recently retired, Lt Col Arnold will serve also as chief, Nuclear Power Division, Office of the Chief of Engineers and as assistant director, Division of Reactor Development and Technology, U.S. Atomic Energy Commission.

The USAERG operates nuclear power plants at Fort Belvoir, Fort Greely in Alaska, and in the Panama Canal Zone. It also trains Army, Navy and Air Force personnel in the operation and maintenance of such plants, conducts a research and technology program, and provides technical and maintenance support to all field plants.

The organization presently has a strength of 28 officers, 10 warrant officers, 224 enlisted men, 92 civilians.

Col Arnold is a 1952 graduate of the U.S. Military Academy and has served with Engineer construction units in England, 1953–1956; with the Army Nuclear Power Program, 1958–1962; as an instructor at the Military Academy, 1963–66; with Engineer construction units in Germany, 1966–69; and with the Construction Directorate, Military Assistance Command, Vietnam, 1969 until his assignment to the USAERG.

Lt Col Harvey L. Arnold Jr.

Graduated from Massachusetts Institute of Technology in 1957 with an ME degree in civil engineering, he has completed training at the Oak Ridge (Tenn.) School of Reactor Technology, and the Army Command and General Staff College (1963).

Included in his awards and decorations are the Legion of Merit, Bronze Star Medal, Joint Service Commendation Medal, and the Vietnamese Honor Medal. He is a member of the Society of American Military Engineers (SAME).

Picatinny Electro-Optical Transmitter Aids Data Retrieval

Use of an electro-optical device and integrated circuitry in a simple, rugged and relatively inexpensive transmitter of data in analysis of a component or integral portion of a rotating body for vibration effects was demonstrated recently by John Bera, electronic engineer, of Picatinny Arsenal, Dover, N.J.

The experimental system was designed as a substitute for a mechanical commutator telemetry system. Bera's objective was to overcome some shortcomings of commutators, such as noise, poor frequency response and difficulties of adaptation to all physical configurations of test items; also, to cut high costs of telemetry systems which performed required tasks in an otherwise satisfactory way.

The electro-optical device, Bera reported, is presently connected for single-channel operation. Multi-channel operation is possible, however, by electronic switching or multiplexing. Caution must be exercised in determining switching rates with respect to data frequency to insure sufficient and valid data collection.

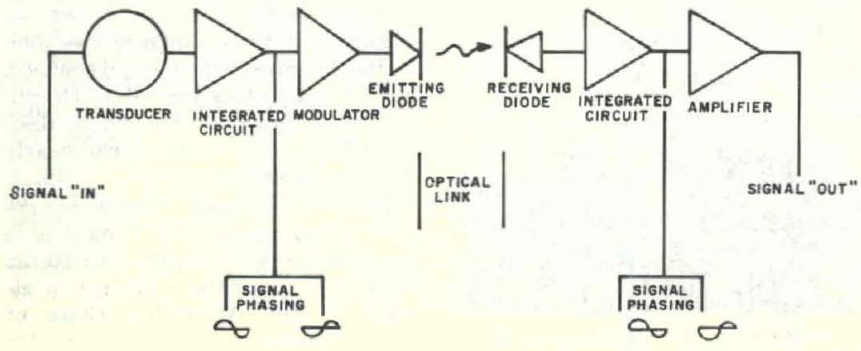
The unit performs the transfer of information desired with a transmitter response "flat" from 200 Hz to 100 KHz and over-all voltage gain of 40, the latter being dependent on the circuit design, optical characteristics and alignment of the two light responsive diodes.

Use of a 7-millimeter focal length lens to focus the light from the emitting diode onto the receiving diode produces an output signal at least twice the magnitude of the voltage at the emitting diode terminals.

The transmitter was developed in conjunction with static vibration analysis tests being conducted on the 105mm rocket assisted projectile (RAP). Final use of this transmitter will be in a spin fixture capable of rotating the round at 9,000 rpm.

The optical system is used to collect information on the vibrational frequencies which exist in the round as a consequence of the ignition and burning of the rocket motor. Characteristic vibration frequencies of the various projectiles are analyzed for improved design and operation of the rounds.

DIAGRAM OF ELECTRO - OPTICAL TRANSMITTER



SCIENTIFIC CALENDAR

Joint National Meeting of The Chemical Institute of Canada and the American Chemical Society, Toronto, Ontario, Canada, May 25-29.

16th Conference of Army Mathematicians, sponsored by ARO-D and MSC, Bethesda, Md., May 27-28.

Seminar on Management Information Systems, sponsored by Control Data Corp., Philadelphia, Pa., June 1-3.

Seminar on Time-Sharing Systems, sponsored by Control Data Corp., Minneapolis, Minn., June 1-3.

Phased Array Antenna Symposium, sponsored by OCRD, MIT and Polytechnic Institute of Brooklyn, Farmingdale, N.Y., June 2-5.

Seminar on Computer Operations Management, sponsored by Control Data Corp., Washington, D.C., June 8-10.

Seminar on Design of On-Line Computer Systems, sponsored by Control Data Corp., N.Y.C., June 8-10.

5th Molecular Crystal Symposium, sponsored by ARO-D, Philadelphia, Pa., June 9-11.

1970 Heat Transfer and Fluid Mechanics Institute Conference, sponsored by ARO-D and NSF, Monterey, Calif., June 10-12.

International Communications Conference, San Francisco, Calif., June 10-12.

Probabilistic Structural Mechanics and Design, sponsored by OCE and NSF, Urbana, Ill., June 15-Aug. 7.

Annual Meeting of the American Society of Radiologic Technologists, Miami Beach, Fla., June 20-25.

5th Symposium on Temperature, Its Measurement and Control in Science and Industry, sponsored by AIP, ISA and NBS, Washington, D.C., June 21-24.

73d Annual ASTM Meeting and 19th Materials Testing Exhibit, Toronto, Ontario, Canada, June 21-26.

6th Berkeley Symposium on Mathematical Statistics and Probability, sponsored by ARO, ONR and AFOSR, Berkeley, Calif., June 22 July 17.

Annual Meeting of the Society of Nuclear Medicine, Washington, D.C., July 6-12.

3d International Powder Metallurgy Conference, N.Y.C., July 13-16.

ECOM Considers A-SCAN Helicopter Guidance System

Safer landing of Army helicopters in small areas during conditions of low visibility by means of an improved guidance system is the objective of an exploratory development effort in the U.S. Army Electronics Command (ECOM) Avionics Laboratory.

The first phase of investigation involves a highly flexible landing guidance signal system, known as A-SCAN, built for the ECOM under contract by the AIL Division of Cutler-Hammer. A-SCAN is an exploratory development model intended to serve two purposes.

Exceptional flexibility of A-SCAN in its operating modes enables research flights under varying approach path conditions. Another purpose is to enable the laboratory to evaluate the technological potential of the scanning beam technique of providing radio guidance signals to serve the Army's tactical needs through further development, if it is found to be appropriate. Meantime, other techniques are being considered.

After final acceptance by ECOM, based upon extensive testing at the instrumented facilities of the National Aviation Facilities Evaluation Center (NAFEC) of the Federal Aviation Administration, A-SCAN will become part of the Avionics Laboratory's "in-house" experimental resources.

Since helicopters have become the foremost type of tactical aircraft used by the Army, development of supporting electronic systems is considered of great importance. While rotary-wing aircraft can use instrument landing systems employed for fixed-wing aircraft, such systems are limited to a single shallow approach path and require large, costly, permanent installations at the airfield.

To take full advantage of the helicopter's ability to land in very small areas, a guidance system especially designed for such operation is needed. A system capable of providing reliable course guidance with approach angles up to 15 degrees or more contrasts sharply with the conventional 2- or 3-degree systems.

The ground portion of A-SCAN consists of the Localizer Guidance Unit, the Glide Slope Guidance Unit, and the Distance Measuring Equipment (DME). Highly portable, these can be set up in less than half an hour and, if desired, operated by battery power. In a final tactical version of a helicopter landing system, all the functions of such equipment, now in separate units for research flexibility, would probably be combined into one unit.

The portion of the A-SCAN equipment carried by the aircraft consists of a radio receiver, and transmitter for interrogating the ground-based part of the Distance Measuring Equipment. The receiver includes a data processor to make the computations required for the final outputs of information to the pilot.

The Localizer Guidance Unit, which has a revolving antenna, transmits microwave signals in a lateral sweep across the desired sector. One of two needles on the course deviation indicator in the helicopter cockpit tells the pilot when he is on the right horizontal approach path.

The Glide Slope Guidance Unit, also employing a revolving antenna, "fires" radio signals over a vertical sector to establish the reference for the descent path (glide slope). Data derived are flashed on the second needle of the deviation indicator to show the pilot his position in respect to the desired descent path.

A critically important feature of A-SCAN is its ability to give an alarm—such as a flashing light or buzz—to warn the pilot if he is approaching the landing site below the minimum safe angle, on a course that would, for example, carry him into such obstructions as trees or hills.

The Distance Measuring Equipment tells the pilot how far he is from the landing site. The airborne transmitter sends signals to the DME, which in turn sends signals back to the aircraft. Distance is determined by measurement of the time between transmission from the aircraft and reception of the reply from the ground.

Although designed primarily for use with helicopters, A-SCAN also can be employed with fixed-wing aircraft, since the pilot can select a desired glide slope. Its wide range of capabilities is expected to provide the Army with means to conduct research into numerous facets of helicopter instrument-landing problems. The over-all goal is to define the precise system characteristics needed for the eventual development of a tactical system.

USAWC Deputy Assigned to Vietnam Support Command

Brig Gen Arthur H. Sweeney Jr., Deputy CG of the Army Weapons Command was assigned to Vietnam May 30 to head the U. S. Army Support Command at Qui Nhon.

Assigned to the Weapons Command in August 1968, he was promoted to general in June 1969. General Sweeney previously has been commanding officer of Watervliet Arsenal (N.Y.) and earlier commanded Springfield Armory (Mass.).

A veteran of 28 years of Army service, he was born in Charleston, W. Va. His assignments have taken him to the Army Ballistic Missile Agency, the U. S. Army Control and Disarmament Agency with the State Department, to Switzerland as a military attache, as an ordnance officer to the 1st Infantry Division and to the U. S. Military Assistance Advisory Group, Cambodia.

He has a BS degree from Massachusetts Institute of Technology, a master's degree in business administration from Harvard University, and is a graduate of the Industrial College of the Armed Forces and the U. S. Army Command and General Staff College.

General Sweeney's successor as deputy CG of WECOM has not been announced.

Brig Gen Arthur H. Sweeney Jr.

MERDC Husband-Wife Employes Honored for 49 Years Service

William V. Thompson and his wife, long-time employes of the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., retired in June after nearly 50 years of combined U.S. Government service.

Employed as a contract specialist in the Procurement Office, Thompson had 27 years of service. Mrs. Thompson, a secretary in the Fuels Handling Equipment Division, had nearly 22 years of service.

Prior to retirement, they were honored by coworkers and friends at a luncheon in the MERDC cafeteria. Each was presented with a Department of the Army Certificate of Achievement.

Fort Detrick Honors Research Chemist With ECSA

William J. Wiswesser, a research chemist at Fort Detrick, Md., was recently presented the Department of the Army Decoration for Exceptional Civilian Service by Dr. Robert Dillaway, Army Materiel Command, Deputy for Laboratories, Washington, D.C.

Signed by Secretary of the Army, Stanley R. Resor, the citation proclaims the pioneering and development of the "Chemical Line-formula Notation System," stating it "is the basis for the most versatile and advanced chemical information handling system developed to date."

The system accomplishes translation of complex chemical formulae into linear expressions, adaptable to computerization, without ambiguity or loss of structural identity.

This contribution of the translation and computerization of chemical structures is widely acclaimed of outstanding value to research scientists. It is used by a growing number of educational institutions, government agencies, research institutes, pharmaceutical houses and chemical industries, both domestic and foreign.

Using organizations include Shippensburg State College, Mills College, Food and Drug Administration, Industrial Liaison Office at Edgewood Arsenal, Fort Detrick, Stanford Research Institute, Winthrop Laboratories, Hoffman-LaRoche, Inc., Eli Lilly and Co., Imperial Chemical Industries, Ltd., Canadian Industries, Ltd., Dow Chemical Co., Olin Mathieson Chemical Corp., Goodyear Tire and Rubber Co. and others.

Reports attest that the system is an accurate, efficient and invaluable tool, with the distinct advantage that its symbols can be punched and printed directly.

Fort Detrick Commander Col E. M. Gershater and his staff, Technical Director Dr. Riley D Housewright and his staff, tenant unit commanders, Fort Detrick laboratory directors, and chiefs of many divisions and offices attended the presentation ceremonies.

Mr. Wiswesser is a graduate of Lehigh University, where he received a bachelor of science degree in chemistry in 1936 and was elected to the academic societies of Tau Beta Pi and Signma Xi. In 1965, he was one of three special alumni initiates to Phi Beta Kappa during the Centennial Anniversary year of Lehigh.

Mr. Wiswesser is also a member of the American Chemical Society, American Industrial Hygiene Association, Frankin Institute, Armed Forces Chemical Association, American Association for the Advancement of Science, and the Reading Chemists' Club.

He has authored over fifty papers on atomic structure and chemical notation and is listed in a number of biographical dictionaries.

William J. Wiswesser (left) is congratulated by Dr. Robert B. Dillaway, Deputy for Laboratories, Army Materiel Command, after he presented him with the Department of the Army Decoration for Exceptional Civilian Service—the highest honorary award that can be granted by the Secretary of the Army to civilian employes.

Einsel Commands Harry Diamond Laboratories

Command of the Harry Diamond Laboratories in Washington, D.C., was assumed June 1 by Col David William Einsel Jr., upon completion of his duties as a joint staff planner, Requirements and Development Division, J5, Office of the Joint Chiefs of Staff.

Lt Col Peter E. Hexner, who has served as HDL commander since October 1968, is resigning from the Army after 19 years service to accept a technical position with Gillette Corp. He has a PhD degree in physics from the University of Virginia (1962).

Col Einsel was in an Arts-Graduate Honors Program at Ohio State University where he received both an MS degree with distinction in physical chemistry and a BA degree cum laude. He also was designated a Distinguished Military Graduate. In 1956 he received an MS degree in physics from the University of Virginia graduate school.

Assigned as a nuclear effects engineer at Edgewood (Md.) Arsenal in 1956, he participated in several nuclear test operations and in 1957 became nuclear assistant to the Deputy Chief Chemical Officer, HQ DA.

In 1960 he was the honor graduate from the Chemical Corps Associate Advanced Course and then was assigned to the United States Military Academy. He served as instructor and later as assistant professor of chemistry until he attended the Command and General Staff College in 1964.

Following duty in Vietnam as chemical officer with the 1st Cavalry Division (Airmobile), he was assigned in 1966 as chief, Nuclear Weapons Effects and Research Section, HQ U.S. Army Materiel Command. He supervised nuclear effects programs of AMC laboratories.

After attending the Army War College, he was assigned in 1968 to the Office of the Joint Chiefs of Staff.

Col Einsel is a member of Phi Beta Kappa, Society of the Sigma Xi, and American Association for the Advancement of Science. His decorations include the Silver Star, Bronze Star for Valor (with OLC), Army Commendation Medal, Purple Heart, Presidential Unit Citation, and Republic of Korea Presidential Unit Citation.

Col David W. Einsel Jr.

WECOM Seeks Suggestions To Set Up Substantial Savings

When Maj Gen Henry A. Rasmussen, CG of the U.S. Army Weapons Command, called for analysis of operations to seek better ways of doing things with decreasing resources, his staff came up with 169 improvement suggestions.

Proposals were examined critically by a group of managers drawn from staff and operating elements. The result was changes in numerous procedures, plans and operations calculated to save $1.5 million in FY 1970.

WECOM is a major subordinate command of the Army Materiel Command with responsibilities for weapons systems, spare parts and equipment involving procurement for the Army and, in some instances, other military services. The current budget is about $684 million.

DoD Approves Relocation of EM Laboratory

Relocation of the Electromagnetic Effects (EM) Laboratory of the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., to an Army facility in the Mason's neck area of Woodbridge, Va., now carries Secretary of Defense approval.

In announcing May 22 that the move will take place when the Mason's Neck facility has been prepared for occupancy this year, MERDC officials said three permanent buildings are available for laboratory and office space. They formerly were occupied by the East Coast Telecommunications Facility of the Army Strategic Communications Command.

Land also is available in the Mason's Neck area for testing purposes.

The U.S. Army Materiel Command of which the MERDC is a part, has authorized the initial move of about 50 military and civilian personnel to the Mason's Neck facility. Mainly civilian physicists and electrical engineers, they average 33 years of age and grade GS–11. The EM Effects Lab currently has four military personnel, including acting chief Lt Col David T. Baker.

Operating presently in the MERDC's North Annex, off Route 95 (Shirley Highway), the EM Effects Laboratory was established as a separate activity in 1969 after being a part of the Electrotechnology Laboratory. Some of its personnel have been using trailers for offices.

Charged primarily with the conduct of research on the effects of the electromagnetic field emitted by a nuclear detonation, the EM Effects Laboratory will have neither explosives nor nuclear weapons for testing.

Instead, testing will be accomplished by means of a simulator producing an electromagnetic field by discharge of a high voltage into an antenna. This electromagnetic field has no adverse effects outside the facility because of its low energy level.

Radiation energy, in fact, will be much less than that produced by the communications facility previously located at the Woodbridge site, the MERDC announcement stated. Simulator devices have been operated by the EM Effects Lab and other labs for many years without producing external hazards, the MERDC reported.

Research conducted by the EM Effects Laboratory, it was explained, contributes to national security by assuring that military equipment, such as the Safeguard Antiballistic Missile System, can function in the event of a nuclear war.

In successfully performing this analytical and experimental research, the EM Effects Laboratory is credited with reducing the need for atmospheric nuclear tests—and thereby contributing to the accomplishment of the limited test ban treaty.

The EM Effects Lab is one of five labs located at the MERDC, the others being Electrotechnology, Mechanical Technology, and Intrusion Detection and Sensor. All of the labs are supported by various staff agencies such as Counsel/Patents, Procurement, Technical and Research Support, Facilities and Services.

Frankford Arsenal 'Teacher' Praised by LaSalle Students

When so many of our college students are finding reason to protest, William B. Fynes, acting associate technical director of the Army's Frankford Arsenal, has received a vote of confidence from the students of the Evening Division, La Salle College, Philadelphia, Pa.

La Salle's dean, Brother Walter J. Paulits, FSC, sent a letter congratulating him for the high praise his courses and he as a teacher have received from senior students, adding that Fynes was "doing much to make the Evening Division experience a rewarding one."

Fynes teaches courses in industrial management, industrial administration and advanced management. He has been employed 17 years at Frankford Arsenal.

Laird Compares Force Deployment

"For the past five years, the United States has virtually been in neutral gear in the deployment of strategic offensive forces, while the Soviet Union has moved into high gear in both deployment and development of strategic nuclear weapons."—(Secretary of Defense Melvin Laird as quoted in Commanders Digest, ***May 2, 1970.)***

Tire Traction Link Improves Vehicle Mobility in SEA

Mobility of wheeled vehicles used by U.S. and allied forces in South Vietnam mud and swamps is improved by a new rotating linkage device said to have extended service life of tire chains 3½ times, reduced maintenance and increased reliability.

Originally developed by the U.S. Army Tank Automotive Command, an Army Materiel Command element at Warren, Mich., the linkage device was first reported in the October 1969 *Army R&D Newsmagazine*, page 42.

Following extensive testing by USATACOM engineers, the device was sent to the U.S. Army Research and Development Center at Aberdeen (Md.) Proving Ground for a 1,500-mile endurance test and three maintenance evaluations.

It was subjected to the torturous durability environment of the Munson, Perryman and Churchville test courses at Aberdeen Proving Ground, where Bruna Sinigaglio was project test director.

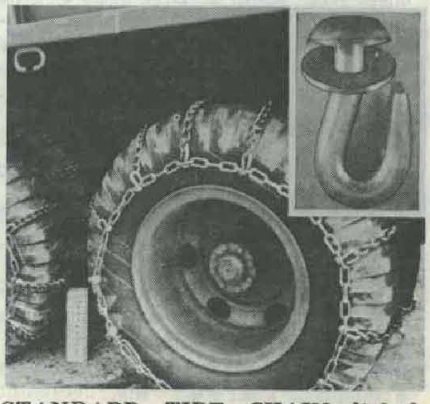
The linkage features swivel hooks as end connectors for tire cross-chains. No tools are required to maintain the chain in field tactical conditions. The assembly can be rebuilt by hand without special tools. Existing cross-chain stockpiles are used for spare parts and it is believed the device will save $1.7 million in five years.

Two types of swivel hooks were involved in the Aberdeen tests. The Code A, or commercial-type hook, is a 3-part assembly consisting of a bent-wire clinch hook similar to the present clinch hook, a rubber roller and a steel hook. This assembly is longer than the Code C military hook and requires a shorter than standard length cross-chain.

An earlier U.S. Army Test and Evaluation Command report determined that the Code A model was unsatisfactory for military use because the chain requires a tool for maintenance, has a short service life, often causes truck damage, and creates a safety hazard.

An advantage of the new military-type chain is that the swivel hook permits the cross-chain to rotate. This exposes more of the hardened chain-link surfaces to wear and substantially increases the useful life of the cross-chain.

The novel design enables the cross-chain to ride on the highest part of the tire's crown, enhancing self-cleaning ability of the cross-chain.



STANDARD TIRE CHAIN linked with rotating swivel device (inset).

Picatinny Arsenal VE Activities Save $5.6 Million

Value Engineering (VE) activities at Picatinny Arsenal, Dover, N.J., as reported recently, claimed economies totaling more than $5.6 million by modifications to materiel production and inspection procedures.

One 9-man team of engineers completed a VE study on an improved 155mm projectile that produced a validated cost reduction in FY 1969 of $1,522,300 and an estimated saving of $1,632,800 based upon FY 1970 procurement levels.

Modifications in six areas of the previously designed projectile were made by Anthony S. Ignacki, Robert Shafran, John A. Dunn, Anthony J. Herold, Henry J. Dazmar, Stanley W. Lieberman, John P. Scanlan, Lawrence M. Green, and Arthur T. Clark, all employed in the Ammunition Engineering Directorate (AED).

Robert Reenstra, Otto Roster, Oscar Alexander and Roland Young, also AED employes, conducted a redesign study of the SUU-7C/A bomb dispenser, resulting in changes that saved $180,742 in FY 1969 with a projected FY 1970 saving of $460,488.

Franklin Cheng, AED, performed a VE study on the stabilizing rod for the 2.75-inch rocket motor. The redesigned rod reduced from 11 to 6 the bending operations in manufacture and eliminated a resizing operation during assembly, resulting in a $70,408 saving in FY 1960 and an estimated FY 1970 saving of $26,585.

Larry Pasternick, AED, is credited with a FY 1969 saving of $120,575 through modification of a fuze adapter assembly for 105mm projectiles. Pasternick also teamed up with Bill Kelting, AED, to reduce the cost of 90mm and 105mm projectile relay and detonator parts. Redesign of each projectile reduced the 6-part assembly to 2 parts for a savings of $65,000.

Donald E. Devine, Harold M. Scheneck, William S. Webster and Frederick Galloway, AED, modified the CDU-14/B canister to save $222,688 in FY 1969, with larger cost reduction expected in FY 1970.

A project by Juris Berzins and Arthur Williams, AED, and Clarence F. Knutsen and Louis Anastasia, Quality Assurance Directorate, resulted in new test and inspection requirements for 60mm ammunition production. Savings of $767,900 in FY 1969 and a projected saving of $570,400 in FY 1970 are reported.

Research Chemist Patents High-Energy-Density Battery

A patent describing a primary (dry cell) battery with a high-energy density and other advantages has been granted to Dr. Klaus H. M. Braeuer of the Electronics Command, Fort Monmouth, N.J.

Dr. Braeuer, a research chemist in the Power Sources Division, Electronic Components Laboratory, has assigned the invention to the U.S. Government.

Dr. Braeuer said the battery, which preferably employs an organic electrolyte and lithium anode, is in the exploratory development stage.

Laboratory tests, in which the feasibility of the battery has been demonstrated, indicate it will have an energy density of about 100 watt hours per pound. This compares with about 20 to 50 watt hours a pound for other military dry batteries.

Other high-energy-density batteries approach or equal the high figure but the battery described in the patent would have a low rate of self-discharge while in storage.

TOW Production Tests Stress System Reliability

Accuracy of the U.S. Army's TOW antitank missile system has been demonstrated by numerous gunners with brief training, but the Missile Command has now acted to achieve the highest possible degree of reliability.

Under a recent directive, Hughes Aircraft Co., prime contractor, was ordered to start pulling missiles off its production line at random and to fire them at Redstone (Ala.) Arsenal —before Army inspectors.

"What we're doing is making sure the Army gets a quality product for its money," the MICOM TOW Project Office explained. These production acceptance tests are planned to continue throughout the production cycle. As of June 8, Hughes had fired 35 TOW missiles at Redstone—with a perfect record of reliability.

The way that the "fly to buy" policy works is that each week a random sample of missiles is made from the production line for test firing. If those missiles perform according to Army specifications, the Army buys that particular lot of missiles.

Award of a $7.7 million contract for support equipment for the TOW system was announced by MICOM early in June. The contract calls for delivery of launchers and optical sensors, and raises the FY 1970 contract value for support equipment to about $16 million.

Members of a West German technical team that visited Redstone Arsenal early in June were much impressed by the accuracy of the system. Commented Walter Bogner, a guided-missile gunner for the Federal Republic of Germany, after a perfect firing record of five direct hits:

"TOW is the most accurate weapon of its kinds I've ever fired."

Other members of the German team, who visited Redstone for a briefing on the TOW, Redeye and Dragon missile systems, were equally impressed. Lt Col Walter-Christian Mueller had a perfect 6-for-6 performance. The team was headed by Maj Gen Gerhard Muench, director of technical troops, and Brig Gen Paul Friedrich Schwartz, Army chief of staff for logistics.

WEST GERMAN TECHNICAL TEAM that visited Redstone Arsenal for a briefing of TOW, Redeye and Dragon missile systems poses with TOE deputy project manager Robert Whitley. From left are Maj Gen Gerhard Muench, director of technical troops, Federal Republic of Germany (FRG) Army; Walter Bogner, guided-missile gunner, FRG Army; Lt Col Walter-Christian Mueller, FRG Army; Col Gerhard Witte, chief, Infantry Department, and Brig Gen Paul Friedrich Schwartz, chief of logistics, FRG Army; and Whitley.

AMMRC Develops Gradient Furnace To Grow Crystals for Armor Research

Transparent armor material requirements may be served effectively by a new method of growing single crystal aluminum oxide (man-made sapphire) from a melt, climaxing three years of effort, the U.S. Army Materials and Mechanics Research Center reports.

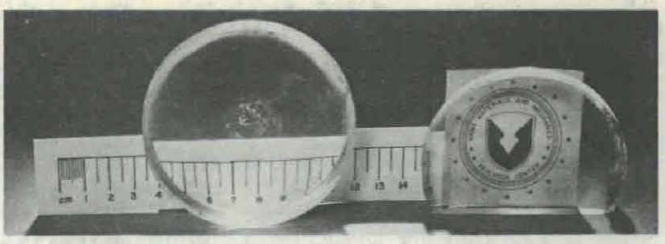
Interested in developing a gradient furnace technique, Dr. Dennis Viechnicki, a research ceramic engineer, and Frederick Schmid, metallurgist, expanded their area of investigation when the Army detailed requirements for transparent armor with good protection and low weight levels. They are *AMMRC* employes at Watertown, Mass.

Originally, their intent was to make sound ingots from melts, but large single crystals became desirable for armor material. Techniques for growth of single crystals were not readily applicable to production of large crystals in significant numbers.

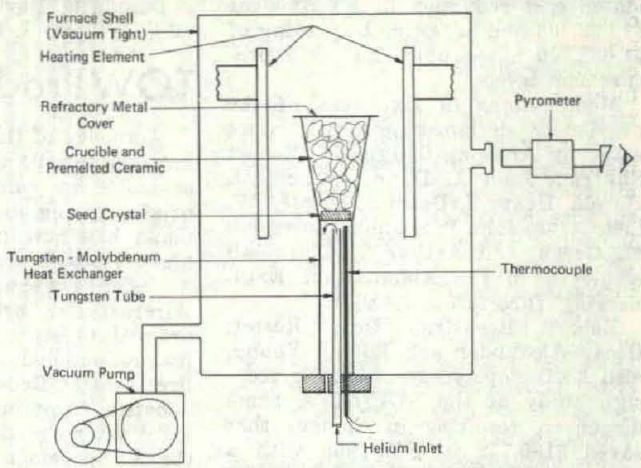
Experimentation with the gradient furnace method led to production of large single crystals by a process found to be reproducible with relative simplicity. The method reportedly has several advantages over other methods with respect to cost, time and ease of shaping. The finished product takes the shape of the crucible used.

Little or no machining of discs is needed, as compared to the heavy machining necessary when other techniques were employed, and it appears the process can be upscaled. The raw material is scrap crystalline alumina, and molybdenum crucibles are relatively inexpensive. Because the product has a low level of residual strains, it is believed that the step of annealing may be eliminated.

Irving Berman, chief of the AMMRC Ceramics Division, considers the new method offers good promise, and that with the proper amount of developmental work might be the answer to the Army's needs for lightweight transparent armor. Because the crystals are extremely heat-resistant, high-temperature material, civilian applications such as high-temperature windows are being studied.



Sapphire discs made by Gradient Furnace Technique



Schematic of Gradient Furnace

3 MICOM Commodity Offices Consolidated in Reorganization

A Land Combat Special Items Management Office has been established to consolidate the Aircraft Weapons, Land Combat Weapons and Sergeant Commodity Offices at the U.S. Army Missile Command (MICOM).

Lt Col Wayne B. Miller has been named acting manager of the new office at Redstone Arsenal, Ala., where he is responsible for directing development, procurement, production, testing, distribution and logistical support of weapons systems, including Sergeant, Honest John and the 2.75-inch rocket launchers.

Formerly product manager of the MICOM MARS II Product Office, Col Miller was assigned to the arsenal in January 1969 from Germany where he was chief of the Joint Sales Branch, Military Assistance Advisory Group. He has a BA degree from the University of Oklahoma and an MBA degree in financial administration from Syracuse University.

Dr. Dennis J. Viechnicki

Dr. Dennis J. Viechnicki is 30 and was graduated from Rutgers State University in 1962 with a BS degree in ceramics. He obtained a PhD in ceramic science from Pennsylvania State University in 1966.

After a brief period of employment with the Westinghouse Research and Development Center in Pittsburgh, he went on active duty as a Reserve officer in the Army Ordnance Corps. Assigned to the U.S. Army Materials and Mechanics Research Center as project engineer and group leader in the Ceramics Division, he stayed on as a civilian in the same position when discharged from the Army in 1968. His research interests have been in the field of high-melting-point oxides, solid-state, and liquid-solid reactions. He is the author of several papers on these subjects and is a member of the American Ceramic Society, Sigma Xi, Tau Beta Pi, and Keramos.

Frederick Schmid

Frederick Schmid is 34 years old and received a BS degree in mechanical engineering in 1959 from Lafayette College, Easton, Pa.

In 1967 he received an ME degree in mechanical engineering from Northeastern University, Boston, Mass., and is taking courses, sponsored by AMMRC at MIT, for a PhD degree in metallurgy and materials science.

His early professional experience in materials science was with the Army Materials Research Agency (AMRA) from 1960 to 1962 as an enlisted man in the Army Science and Engineering Program. As a civilian he joined the Watertown Arsenal Operation Division as a production metallurgist in the Foundry Branch.

After working five years in casting and unidirectional solidification, meanwhile earning an MA degree, he joined the Ceramics Research Laboratory in 1967. He is presently working with Dr. Viechnicki in controlled and unidirectional solidification of ceramics, an almost totally unexplored area of ceramics processing, and has authored or coauthored eight technical papers. He has five patents and pending patents in controlled solidification techniques.

PROMAP-70 Promotes Reduction of Over-Age Contracts, Change Orders

Reduction of over-age letter contracts and change orders to zero—one of the main objectives of the Army Materiel Command's PROMAP–70 (Program for Refinement of the Materiel Acquisition Process)—is being promoted with stimulating success.

Letter contracts, which long have been subject to criticism as an inefficient (from a cost standpoint) but necessary method (from the view of expediting emergency action), are defined in the Armed Services Procurement Regulation (ASPR):

"A written preliminary contractual instrument which authorizes immediate commencement of manufacture of supplies or performance of services, including, but not limited to, preproduction planning and procurement of necessary materials."

A change order is an engineering or administrative change to a contract, and a letter contract or change order is considered over-age if it is not converted to a definitive contract within 180 days after award.

Progress in the PROMAP–70 objective is reflected by results in a 9-month period—reduction of over-age letter contracts from $552 million as of June 30, 1969, to $177 million as of Mar. 31, 1970. This has been accomplished by establishment of milestones to definitize letter contracts within six months and by close controls.

Similar controls now are in effect for change orders of $10,000 or more. Insuring definitization of contract changes at the earliest practical date has decreased the number of over-age change orders from 1,008 to 837 between Sept. 30, 1969 and Mar. 31, 1970.

Mrs. Margaret V. Smith, PROMAP–70 task director for "Definitization of Contracts/Changes" in AMC's Directorate of Requirements and Procurement, pointed out that in FY 1969 AMC awarded letter contracts valued at $1.7 billion—out of a total of $7.7 billion of AMC expenditures for procurement of hardware and munitions.

PROMAP–70 is AMC's implementation of the Secretary of the Army's over-all program to field, economically, better weapon systems and equipment, and is directed by Maj Gen Paul A. Feyereisen, Deputy CG for Materiel Acquisition.

Improving weapon system acquisition, he continually emphasizes, hinges to a great extent on reducing the cost growth in the procurement of weapon systems. Over-age letter contracts and change orders contribute to this cost growth.

Although it is a binding contract document, a letter contract does not reflect complete agreement as to all precise terms and conditions. It defines what is being purchased and most terms and conditions, but lacks complete agreement as to price.

Concern over this procurement method is that the government's bargaining position is weakened, and the contractor's risk is significantly reduced during the period between award and definitization—thus opening the door for increased cost. However, it can save four to five months in negotiating a definitive contract.

AMC's new policy is that a letter contract is the least desirable method of procurement, and will be used only where facts exist to sustain the conclusion that no other contract type is suitable.

Each decision to use a letter contract will be documented to justify its use, including a realistic time-phased plan for definitization. HQ AMC reviews each decision to assure full compliance with this policy.

Dr. J. Ronald Fox, Assistant Secretary of the Army (Installations and Logistics), in a recent letter to General F. J. Chesarek, AMC CG, stated:

"This (AMC) report shows that letter contracts on hand and over-age are well under the Fiscal Year 1970 Logistics Performance Management Evaluation System goals established for your Command. . . . I am confident that continued diligence on the part of all concerned will insure that patterns of reduction in the use of this type of contract continues. Please convey my best wishes for continued success to all personnel involved in this effort."

AMC has initiated several steps to control engineering change orders, which increase costs and delay production, in two areas in its PROMAP–70 campaign: the necessity for issuance, and follow-up to insure timely definitization.

The AMC Directorate of Research, Development and Engineering (DRD&E) is responsible for the Configuration Management Program under which there has been established an Engineering Change Control/Cost Center at the Electronics Command, Fort Monmouth, N.J., as a test-pilot program.

The task of DRD&E is to evaluate proposed changes in terms of cost, schedule and technical impact; provide continuous review of current and past actions relating to configuration control (identification of equipment, control of changes, accounting of changes); and assure command level visibility to all engineering changes.

Complementing this effort, the Directorate of Requirements and Procurement has established a program whereby it identifies all over-age change orders of $10,000 or more; determines the cause of delay in definitization; and establishes a realistic time-phased plan for definitizing each change order.

Edgewood Deputy CO Assigned to Flight Training Center

Col Walter J. Davies, deputy commander of Edgewood Arsenal, was reassigned recently to Fort Stewart, Ga., as G–1 of the U.S. Army Flight Training Center at Fort Stewart Ga.

A 30-year veteran of Army service, he was assigned in 1940 to the Eastern Defense Command with Armored Cavalry units. He had duty as an intelligence staff officer at HQ Far East Command, Tokyo, Japan, from 1945 to 1950.

Col Walter J. Davies

Other assignments have taken him to Germany, where he was commander of the 836th Tank Battalion, and to Korea, where he served as Assistant Chief of Staff, G–2, HQ 7th Infantry Division. He served from 1958 to 1962 as staff officer in the Office of the Deputy Chief of Staff for Personnel in Washington, D.C., and was chief of the Armor Human Research Unit, Fort Knox, Ky. (1963–65).

A 1945 graduate of Michigan State University, Davies has completed the Cavalry and Armor Schools, and Command and General Staff College.

His decorations and awards include the Army Commendation Medal, World War II Victory Medal, Occupational Medal (Germany), American Theater Ribbon, United Nations Service Medal, Korean Service Medal, and the National Defense Service Medal.

Major Army RDT&E, Procurement Contracts Exceed $398 Million

Awards for helicopters and related components accounted for $94,588,896 of Army RDT&E and procurement contracts totaling $398,181,796 from Mar. 15 to May 1. Only contracts exceeding $1 million are included.

Boeing Co. will receive $50,970,732 (three contracts) for CH–47 helicopters and modification kits, transmissions, servo-cylinders, shipping and storage containers, inspection kits and publications requirements for the aircraft.

Bell Helicopter Co. will be paid $43,618,164 (six contracts) for AH- and UH-series helicopters, including repair of crash-damaged aircraft.

Olin Corp. gained six contracts totaling $32,746,543 for operation of ammunition and propellant producing facilities and for loading, assembling and packing of cartridges.

Mason and Hanger-Silas Mason Co., Inc., was awarded two contracts totaling $18,675,066 for loading, assembling and packing bombs and projectiles. General Motors Corp. won five contracts totaling $12,439,052 for diesel and turbine engine work and for R&D and interim advance production engineering efforts on the Main Battle tank.

Beech Aircraft Corp. will be paid $12,327,434 for fixed-wing utility aircraft; Hercules, Inc., $10,838,876 (two contracts) for propellants; and National Presto Industries, Inc., $10,212,212 for parts for projectiles.

Contracts under $10 million. Harvey Aluminum Sales, Inc., $9,135,681 for operation of ammunition facilities; Gulf and Western Industries, Inc., $8,759,450 (two contracts) for cartridge cases; Thiokol Chemical Corp., $8,404,782 for illuminating signals; and

Western Electric Co., $8,323,710 (two contracts) for a communication system at Kwajalein Missile Range and for components for the Safeguard Missile Site Radar; and

Uniroyal, Inc., $6,933,044 for operation of ammunition production facilities; National Presto Industries, Inc., $6,696,800 for projectile parts; Chrysler Corp., $6,365,304 (two contracts) for plant equipment and system engineering management for the M60A1E2 tank program; and

Sanders Associates, $5,698,563 (two contracts) for FY 1970 pilot production engineering services and production engineering services for Forward Area Alerting Radar; and

Hughes Aircraft Co., $5,500,000 (two contracts) for repair parts for the TOW weapons system and for night vision systems; KDI Precision Products, Inc., $5,256,651 (two contracts) for fuze parts; and

Control Data Corp., $5,083,351 (two contracts) for operation of the Tactical Operations Systems at HQ U.S. Army, Europe and for automatic data processing equipment; Maxson Electronic Corp., $5,069,228 for rocket clips.

Contracts under $5 million. Chamberlain Manufacturing Co., $4,955,175 (three contracts) for parts for 2.75-inch rocket warheads; Hamilton Watch Co., $4,852,552 (two contracts) for parts for rocket fuzes; Xerox Corp., $4,657,000 (two contracts) for gated night sights for the TOW missile system; and

Teledyne Industries, $4,176,177 for engine assemblies for M60 and M48 tanks; Norris Industries, Inc., $4,125,600 for motor tubes for 2.75-inch rockets; AVCO Corp., $3,870,400 (two contracts) for metal parts for rocket fuzes and for conversion kits for CH–47 helicopter engines; and

Ingraham Industries, $3,543,284 for fuzes; Bulova Watch Co., $3,508,820 for parts for fuzes; Northrop Corp., $3,437,500 for 2.75-inch rocket warheads; Heckthorn Manufacturing Co., $3,336,683 for 40mm projectiles; Airport Machining Corp., $3,269,400 (two contracts) for parts for 2.75-inch rocket warheads; and

Marquardt Co., $3,176,400 and Jackson Products Co., $3,134,700 for nozzle and fin assemblies for 2.75-inch rockets; IBM Corp., $3,000,000 for electronics; and

Aluminum Co. of America, $2,980,744 for bridge-erection boats; Hoffman Electronics Corp., $2,816,250 and FTC Corp., $2,443,500 for nozzle and fin assemblies for 2.75-inch rock-

In-House Personnel Modify WSMR Nuclear Reactor

Modification of the fast-burst nuclear reactor at White Sands (N. Mex.) Missile Range is being accomplished by "in-house" personnel—the first time that such work has been performed except by outside agencies.

Much in demand for experiments because of the above-ground nuclear weapon test moratorium, the fast-burst reactor is used in simulation tests to determine radiation effects of a nuclear weapon detonation on missiles, weapons, and other equipment.

Modification to increase the radiation output involved reboring the reactor's safety block, which fits into the reactor core, to provide space inside it for testing small components. About three times the former radiation strength will be provided for testing items such as semiconductors.

BORING JOB on safety block of fast-burst nuclear reactor was accomplished in 2-hour shifts by Kenneth H. Seifert (pictured above) and Bob Carson, in precision machine shop at White Sands (N. Mex.) Missile Range.

Russell A. Boor and Don J. White of the Directorate of Nuclear Effects supervised the modification work, including the radiological safety aspects. Bob Carson and Kenneth H. Seifert of the precision machine shop alternated on the reboring job.

Work was performed in a protected area of the nuclear effects facility rather than in the post machine shop to avoid exposing a large number of workers to radiation doses.

The safety block is composed of 90 percent uranium to provide a near critical mass for the reactor. Carson and Seifert were exposed to it for only two hours at a time. After one had reached the maximum exposure level, the other machinist replaced him.

The safety block will be sent to the Los Alamos (N. Mex.) Scientific Laboratory to be plated with aluminum and is expected to be back in operation by September.

Used also by the Nuclear Effects Directorate to provide nuclear environments for weapon effects testing are a linear electron accelerator (gamma linac) and a steady-state neutron generator.

The linear electron accelerator is capable of simulating the gamma radiation from a nuclear explosion. Simulation of a neutron spike present in a fusion weapon or hydrogen bomb is done with the steady-state neutron generator.

ets; Magnavox Corp., $2,742,061 for airborne radio sets; Lear Siegler, Inc., $2,742,000 for fuze parts; and

White Motor Corp., $2,712,845 for engineering services for trucks; Pettibone Corp., $2,600,341 for truck cranes; Aerojet Solid Propellant Co., $2,449,000 for performance of Phase I of a Controllable Solid Rocket Motor Program; and

American Air Filter Co., Inc., $2,442,980 for trucks and firefighting equipment sets; Pace Co., $2,277,626 for ground illumination signals; Magline, Inc., Philadelphia, Pa., $2,275,262 for electrical equipment shelters; and

Penn Akron Corp., Long Island City, N.Y., $2,104,200 for metal parts for fuzes; Firestone Tire and Rubber Co., $2,208,505 for loading, assembling and packing of projectiles and components.

Contracts under $2 million. Cornell Laboratories, $1,800,000 for a study on terminal discrimination; Texas Instruments, Inc., $1,750,000 classified letter contract; Bridgeport Brass Co., $1,718,366 for cartridge case cups; Eisen Brothers, Inc., Lodi, N.J., $1,657,096 for 40mm projectiles; and

Institute for Defense Analysis, $1,634,125 for research for the Director of Defense Research and Engineering and for the Advanced Research Projects Agency; Gibbs Manufacturing and Research Corp., $1,585,800 for rocket fuze parts; and

H. O. Boehme, Inc., Westbury, N.Y., $1,570,472 for gyro-magnetic compass sets and ancillary items; General Time Corp., $1,557,360 for metal parts for rocket fuzes; Batesville Manufacturing Co., $1,557,270 for metal parts for bomb fuzes; and

Rone Plow Co., $1,554,348 for tree dozers; Eureka Williams Co., $1,542,060 for bomb fuze parts; Marathon Battery Co., $1,520,000 for production testing and engineering samples; and

Medico Industries, Inc., $1,489,500 for metal parts for 2.75-inch rockets; Lehigh, Inc., $1,470,000 for parts for rocket warheads; I. D. Precision Component Corp., $1,457,400 for parts for mortar fuzes; and

Honeywell, Inc., $1,449,092 for fuze parts; International Harvester Co., $1,432,134 for maintenance trucks; Sylvania Electronic Systems, Inc., $1,300,000 for a classified study; Colt's, Inc., $1,290,678 for rifles; University of Wisconsin, $1,280,000 for basic research on interdisciplinary research in the mathematical sciences;

Southwest Truck Body Co., Inc., $1,227,630 for semitrailer vans; General Electric Co., $1,184,025 for design, manufacture and installation of generators; Chandler Evans, Inc., $1,136,520 for conversion of fuel controls for UH–1 helicopter engines;

E. I. du Pont de Nemours and Co., $1,064,840 for TNT; Revere Copper and Brass, Inc., $1,021,510 for bullet jackets; Raytheon Co., $1,020,000 for engineering services for the Hawk Missile System; International Telephone and Telegraph Corp., $1,017,922 for engineering changes to AN/GRC–143 radio sets; and Communication and Systems, Inc., $1,000,000 for classified research and development.

2 ECOM Papers Delivered at ASME Conference

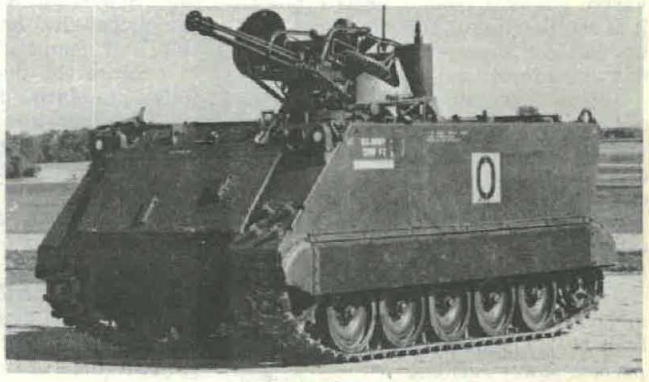
Two Army Electronics Command technical papers were delivered at the 1970 Design Engineering Conference sponsored by the American Society of Mechanical Engineers in Chicago, May 11–14.

"New Concepts for Recharging Electrochemical Batteries" was presented by David Linden, acting chief, Power Sources Division, Electronic Components Laboratory (ECL). "Electronic Solid State Device to Reduce Voltage Transients from Power Supplies of Moving Equipment" was authored by Bernard Reich, deputy chief, ECL Solid State and Frequency Control Division, and given by Frank J. Wrublewski, chief of the Power Systems Branch.

Linden discussed new techniques, developed under Army programs, for rapid recharge of storage batteries in military, commercial and home use. Army development of new electrochemical systems, metal-air batteries and fuel cells has reached the advanced model stage and offers radically new non-electrical recharging concepts.

An example is a metal-air battery recharged by the simple replacement of a discharged electrode. Fuel cells under development require only a continued supply of solid or liquid fuels. The Army's new thermoelectric generator operating on almost any liquid fuel also was discussed.

The solid-state device described in Reich's paper is a high-powered zener diode. It can be used to suppress voltage variations that might damage the entire electrical system of a vehicle or only to protect a piece of electronic equipment, such as a radio.



VULCAN AIR DEFENSE (VAD), the first shell-firing weapon system to be adopted as standard since the World War II era, has entered new testing phases at the Materiel Test Directorate, Aberdeen Proving Ground, Md. Both the XM167 towed (left) and the XM163 self-propelled (right) versions are undergoing quality assurance testing of production systems. Additionally, product improvement tests are being made on a new radar system for the modern multibarreled Gatling gun. Developed as the primary armament for the Army's newest unit, the Chaparral/Vulcan battalion, the VAD's 6-barrelled 20mm cannon has a dual rate of fire of either 3,000 or 1,000 shots per minute. During the development phase, the self-propelled version of the system was successfully employed for ground support missions in Vietnam.

Mobile Electric Power PM Addresses SAME on PROMAP-70 Progress

Forty-two project managers in the U.S. Army Materiel Command have responsibilities critical to success of PROMAP–70 (Program for Refinement of the Materiel Acquisition Process), involving billions of dollars a year.

Each of these key positions requires a highly selective level of professional competence, as typified by Col J. J. Rochefort Jr., Department of Defense PM for Mobile Electric Power. Problems and progress in performing his duties were detailed when he recently addressed the Columbus (Ohio) Post of the Society of American Military Engineers (SAME).

After pointing to the uncontrolled proliferation of engine generators designed specifically for an end item of materiel or a system—resulting in acute maintenance complications arising from a variety of configurations and operational characteristics—Col Rochefort continued:

"To give you a feel of the magnitude of the problem, in late 1965 over 2,000 different makes and models of generators were being carried in the Defense inventory. Recognizing the gravity of the situation, the DoD directed that a project manager be assigned for the engine generator program or, as it was referred to then, the engine generator problem.

"The project manager's mission is to develop fully coordinated procurement data packages to be used to field a DoD standard family of engine generator; also, to assure that the Military Services use the members of this standard family and not fall back upon unique, one-of-a-kind generators.

"If there is one paramount and pervasive goal for mobile electric power, it is the fielding of this standard family and the determination to require our users to utilize it.

"Without going into detail on the composition of the standard family, suffice it to say there are 43 members classified mainly as tactical sets. Others are prime sets, more normally considered post, camp and station-type generators operating as a power grid.

"Within the tactical field, precise and utility power is furnished with both 60 Hz and 400 Hz modes in the precise power ratings.

"By the end of this fiscal year, all members of this first-generation family will be represented by fully coordinated procurement data packages to meet requirements of the Military Services. In addition, those ratings for which a funded program exists today will be under contract.

"Effort is now being concentrated on the second portion of the mission —assuring that the user utilizes these sets rather than a unique set keyed to his particular system. First, the user, and particularly the developer, must have a catalog of generator sets he can procure, represented by the MIL–STD–633 series. He also must have a MIL–STD–1332 document that clearly outlines the technical and physical characteristics and capabilities of the members of the family. With both of these documents available to the developer, it is incumbent upon him to select the generator set that most closely meets his needs.

"In those rare cases where there is no family member to meet specifically his requirements, a developer has two options. He may submit a request for deviation through his service staff and then to the project manager for ultimate approval or disapproval. This deviation authority has been difficult to achieve in the past, and I can assure you will be virtually impossible in the future.

"This fact does not mean, however, that the developer must compromise his system or end item. His second option is to condition the power furnished by the family member and include such conditioning equipment on his end item. This, of course, is the preferred approach.

"Before discussing trends that I foresee, I believe it germane to indicate my concept regarding procurement of the standard family members. A procurement that is not fully competitive is categorized as a poor procurement.

"Standardization to preclude the proliferation of the past is also vitally important. To bridge the apparent dichotomy between standardization and competition, we have hoped to procure the great majority of the DoD standard family of electric power generators under a modified military design concept.

"We will have the full rights, data and drawings to MIL–STD–1000 Category E for each set with exception of the engine, which was selected competitively from the existing QPL. Reprocurement can be fully competitive for large business or small business, for the manufacturer or assembler.

"The Government is assured of getting the same item, with interchangeable parts, year after year. A corollary to the military design concept has been that of assuring the maximum commonality between generator sets of different ratings. This has been done from the outset and will assist even further in reducing the logistic burden.

Col J. J. Rochefort Jr.

"Maximum use is made of the kit principle to take care of specialized requirements or environmental requirements, such as winterization kits, mobilizer kits or load banks, to mention but a few.

"Now, using an oblong crystal ball, here are some of the trends I see. First, consumption of electric power by the military is growing even faster than the national debt or price of meat. After Korea, military planners considered that one-half of a kw. per man deployed in an overseas theater was adequate.

"In Vietnam we have furnished over 2½ kw. per man—5-fold increase in little more than a decade. If you prefer bulk figures, we have furnished more mobile electric power capacity in Vietnam than is commercially installed today in the State of Hawaii.

"I see this consumption trend continuing to grow. Another trend has developed. If you remember, in the early 50s and even well into the 60s, reduction in size, weight and cube of generators was the watchword of the day. An item that was smaller, that weighed less, was by definition better than what we had had before.

"This trend is reversing itself. Size, weight and cube are no longer the paramount requirement for engine generators. This has been replaced as the dominant factor by what I believe is far more important—reliability.

"Reliability is now the one most important characteristic for engine generators, and is normally associated with the mean time before failure. To give you a feel, today our average generator used by the Military Services has a mean time before failure of approximately 150 hours. Our first-generation DoD standard family has a requirement for a mean time before failure of no less than 500 hours.

"Hence, our goal is a 3-fold increase in reliability. As we move to

the follow-on family powered by turbines, we believe a mean time between failure of 1,200 to 1,500 hours is well within the state-of-the-art. Tied to this dominant characteristic of reliability is endurance.

"Today, the average gasoline-driven set has an endurance or mean time between overhaul of 1,500 hours while our diesel sets have 4,000 hours. The gasoline sets are currently being improved by work on ancillary equipment, with a goal of 3,000 hours, and there will be a mean time between overhaul of new diesel sets of 5,000 hours. As we move to the turbine-powered sets, we feel that 10,000 hours is well within the state-of-the-art.

"Another trend gaining emphasis is that of increasing the maintainability of our engine generators. Operators are normally not furnished for engine generators in the field; hence, most of them do not receive the close and continuing maintenance currently required. We are attempting to reduce the maintainability requirements to a point of achieving the most maintenance free operation possible and concurrently reducing mean time to repair by approximately 200 percent.

"I think the last trend that will really have an impact on the engine generators of the future is an increasing requirement for silence and lack of signature. This requirement, we feel, is the most difficult to achieve and will most certainly require a substantial trade off from a point of view of size, weight and complexity.

"In conclusion, I would like to touch briefly on those power sources we expect will be entering the inventory in the 1975–85 time frame. First, we do not see any one power source replacing our current gasoline and diesel-driven sets on a one-for-one basis. I believe that in 1985 there will still be gasoline-driven sets as well as diesel-driven sets in our inventory in substantial numbers.

"We do see, however, certain other power sources coming into the inventory in a somewhat limited quantity to meet specific requirements. First, turbine sets will definitely be available. The reduction in size and weight with the concurrent increase in reliability and endurance of the turbine-driven sets will make them most cost-effective and desirable. The disadvantage is higher fuel consumption and higher initial cost.

"Within the turbine-driven sets, efforts are under way to develop a turbo-alternator rated at 10 kw. This consists of a single-shaft turbine and solid rotor, rotating at 94,000 rpm, delivering a wild frequency of approximately 1,700 Hz and converted through a solid-state converter to either 60 or 400 Hz for the user. We anticipate this set will enter the inventory beginning in 1975.

"Two technologies are competing for the smaller sets—that of the closed organic rankine cycle engine and that of the open hydrocarbon fuel cell. Both of these systems have the potential to replace many of our smaller sets; i.e., less than 3 kw.

"This is the future for mobile electric power as seen from the project manager's viewpoint. I am convinced that upon fielding of the standard family of generators in quantity, the mission assigned by the Secretary of Defense in 1967 will have been achieved. Proliferation will have been halted. The one-of-a-kind generators will have been eliminated. Reliability will have been dramatically improved and the logistic burden greatly reduced. This is our goal. I am confident that we will achieve it."

AMC Creates Special Quality Assurance Task Force

Weapons and equipment requirements for simplicity, reliability and maintainability are receiving increased emphasis throughout the U.S. Army Materiel Command, in line with reductions in funding and manpower levels.

General F. J. Chesarek, commanding general, has designated a special task force in the Quality Assurance Directorate at HP AMC to stimulate consideration of simplicity, reliability and maintainability in engineering design.

Particular attention is directed to major systems in development expected to be fielded for combat in the mid to late 1970s. The task force is one of 50 involved in Project PROMAP–70 (Program for Refinement of the Materiel Acquisition Process).

In this concept, materiel acquisition includes research, development, procurement and production involved in providing Army weapons and equipment.

Staffed with specialized engineers and technicians, the AMC Quality Assurance Directorate develops total quality assessment policy and procedures. The PROMAP–70 task force has worked in this area and has conducted intensive studies of the life cycle of selective hardware and equipment.

AMC quality and reliability engineers gave special attention to the reporting techniques and data submitted on reliability requirements by the commodity commands and project managers. Consideration was devoted to the four phases of material: design and development; procurement and production; fielded equipment; and stockpiling.

Data were sifted and analyzed in order to surface maintainability and reliability problems, with particular emphasis on tracking corrective actions. Analysis of these reports is considered a powerful management tool for evaluating over-all effectiveness of the subordinate command's approach for assuring reliability and maintainability of key materiel items.

Critical examination was made of reliability life-cycle reports of selected Army aircraft, electrical materiel and missiles such as the Chaparral, Dragon, Basic and Improved Hawk, Lance, Nike-Hercules, Pershing, Redeye, Sergeant, Shillelagh and TOW.

Quality Assurance Engineers are currently following intensively the progress record of the SAM–D missile, which is in the advanced development stage.

Other studies were made of AMC's mobility equipment (such as Mobile Floating Assault Bridge, LARC XV), munitions materiel, tank-automotive materiel (such as the GOER vehicles and tanks) and weapons materiel (including the Sheridan, helicopter systems, M16A1 rifle, and M60A1E2 tank.

Problem areas highlighted in the study demonstrated that improvement was required for some items which are not meeting complete reliability and maintainability standards.

The PROMAP–70 task force evolved a program identified as RISE (Reliability Improvement of Selected Materiel) for AMC's commodity commands and project managers. Problem items are evaluated to determine which improvements offer the greatest potential pay-off, by either extending the military life of the equipment or reducing maintenance and logistic support costs.

Field data regarding logistic and maintenance support costs, demand rates for replacements or overhauls, and accident rates are used in considering improvements.

The task force is emphasizing that extensive redesign of standard equipment is to be avoided. Only cost-effective improvements are recommended, based on analysis of remaining inventory life, need for replacement by follow-on equipment, changing mission requirements, age of equipment and cost of proposed improvement.

The final step is the follow-up on implemented improvements to verify the actual improvement achieved.

An example of cost-effective improvement from the quality assurance point of view is the value engineering

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AMC Creates Special Quality Assurance Task Force

(*Continued from page 47*)

study of the track shoes used on the M113 family carrier, conducted at AMC's Tank-Automotive Command at Warren, Mich.

Personnel vehicles had a proven life expectancy of 3,000 miles, as supported by statistical analysis of track test data. The VE study was directed to the objective of increasing the life of the T130 track shoes to produce a better quality component and yield a life expectancy of 5,000 miles.

As a result of the study, it was decided to use "4140" alloy steel instead of "1345" steel, and a more stringent inspection of specification compliance was developed. Results produced crack-free track shoes with an increased service life of 2,000 miles and FY 1970 savings of $1,131,000. FY 1971 savings are estimated at $2,497,000 and for FY 1972 $2,493,000 (3-year total: $6,121,000).

In the design and development phase of improving materiel acquisition, the task force recommended a life-cycle approach aimed at achieving "systems effectiveness" by integrating quality and reliability engineering with total engineering effort.

In the tasks performed under the primary mission of assessment and evaluation, and support role of providing services to the over-all design and development effort, it is being emphasized that the quality engineer be a contributing as well as a participating member of the engineering team.

A. H. Nordstrom, the PROMAP–70 task director and chief of AMC's Quality Engineering Division of the Product Assurance Directorate, emphasized that "design responsibility of an item program is clearly that of the appropriate research and engineering element. Designs are inherently reliable and safe because of the characteristics of the design itself.

"The assessor and evaluator can do no more than record and report his findings. Ideally, the safety and reliability assessment and evaluation will be a continuing function of the item engineering team representing an integration of activity on the part of the design and quality engineers."

Quality assurance studies dealing with the procurement and production phase of the life-cycle of Army materiel also reveal the importance of coordination between product quality specialists (engineers) and the other engineering elements to resolve inadequacies or inconsistencies in the technical data package.

Action has been taken to incorporate reliability requirements for all critical components in the production contract. Quality assurance clauses will be placed in contractual documentation, and data will provide the background necessary to participate in pre-award surveys.

The task force has underscored the importance of the quality assurance activities in the stockpile phase of equipment and weapons. It has spelled out the primary mission of quality assurance, such as establishing serviceability standards—with engineering concurrence.

The task force designs, develops and provides stockpile laboratory and firing program equipment, instrumentation and procedures. It conducts at the appropriate commodity center, the stockpile laboratory and furnishes on-site supervision over firing programs.

The survey of commodity commands and project managers disclosed that reliability engineering staffing at several commands was not adequate. As a result, a headquarters directive has been issued to implement General Chesarek's commodity command organizational guidance.

Top priority is being given to the establishment of a Reliability and Maintainability Division (composed of quality engineers) in subordinate command product assurance directorates.

The grade structure is also under study for revision so that the office will be staffed with competent engineers. The total product assurance personnel strength in all project manager's organizations is expected to increase from approximately 100 to 280. Similar strengthening of commodity command product assurance organizations is under way.

Col Clarke to Succeed Albertson as RIA CO

Col Frank P. Clarke is assigned to take command of Rock Island (Ill.) Arsenal in July, succeeding Col James J. Albertson, assigned to Vietnam after serving as CO since March 1968.

Col Clarke was assigned to the Directorate for Logistics, Organization of the Joint Chiefs of Staff before he began the National War College, from which he will graduate in June. He also has completed the Armed Forces Staff College and the Army Command and General Staff College.

Enlisted in the Army in 1942, he won an appointment to the U.S. Military Academy (USMA) following Field Artillery and Corps of Engineer assignments and was graduated in 1949. He obtained an MS degree in engineering science from Purdue University in 1956 and then served as an instructor and associate professor at the USMA.

Col Frank P. Clarke

Col Clarke commanded the 123d Maintenance Battalion, 1st Armored Division and the 9th Support Battalion of the 198th Infantry Brigade at Fort Hood, Tex. Deployed to Vietnam with the 9th Support Battalion in October 1967, he later became assistant chief of staff, G–4, Americal Division in Chu Lai.

During 3½ years with HQ Seventh Army in Europe, he served as chief, Plans Branch, chief of the Operations Branch, and chief of the Operations Division, Ordnance Section.

He has been awarded the Legion of Merit, Air Medal, Army Commendation Medal with Oak Leaf Cluster, and the Vietnam Staff Medal of Honor.

Aberdeen PG Office Chief Selected to Tour Japan Among 15 ICAF Students

Robert L. Johnson, chief of Aberdeen (Md.) Proving Ground's Management Science and Data Systems Office, is one of 15 students of the Industrial College of the Armed Forces selected for a 2-week tour of Japan.

Since August 1969 he has been attending the ICAF course at Fort McNair in Washington, D.C., where he was in a class of 180 military and civilian representatives of all branches of the Armed Forces.

The ICAF students will meet with Japanese leaders in government and industry to stimulate a better understanding of problems of mutual interest to Japan and the United States.

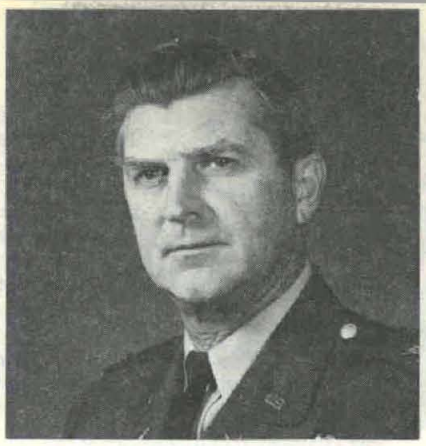
The ICAF course, which concerns the study of economics and political and military factors influencing the defense program, ended in June.

Col Lynch Takes Command Of ARO-Durham; Col Rosen To Return as Assistant DAR

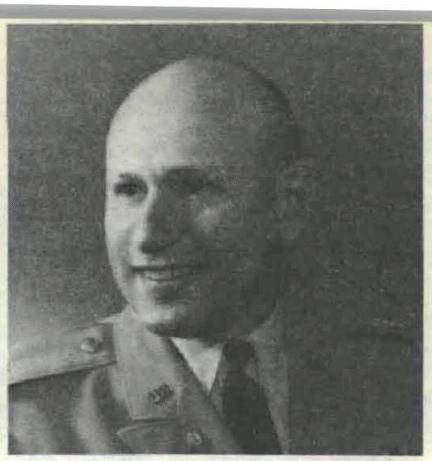
Command of the U.S. Army Research Office/Durham, N.C., was assumed in mid-June by Col William J. Lynch. Col Norman R. Rosen, now in Vietnam, is slated to succeed him Sept. 1 as Assistant Director of Army Research and CO, Army Research Office, Washington.

Prior to assignment to ARO-Washington in August 1967, Col Lynch served two months as chief, Technical Information Liaison Office, Office of the Chief of Research and Development, HQ DA, following two years in Hawaii as assistant chief of staff, G2/G3, U.S. Army, and another year as deputy chief of staff.

From 1961 to 1964, he was project manager, Remote Area Conflicts Office, Advanced Research Projects Agency, Office, Director of Defense Research and Engineering. In 1960–61 he served ARPA as Army assistant to the director. Other assignments have included a year in the OCRD Plans Division, HQ DA (1959–60) and three years in Boston, Mass., as CO, 739th Nike Battalion.



Col William J. Lynch



Col Norman R. Rosen

Col Lynch has a BS degree in mechanical engineering from Tufts College of Engineering and an ME degree from the Guggenheim School of Aeronautical Engineering. He is a graduate of the Guided Missile School, Artillery Officers Advanced Course, and Command and General Staff College.

COL ROSEN is currently chief, Lines Communications Division, U.S. Army Military Assistance Command, Vietnam, where he has served since December 1969, following six months as chief, Engineer Division, HQ U.S. Army Engineer Construction Agency, Vietnam.

In returning to the Army Research Office, Highland Building, Arlington, Va., he will have occasion to remember his role as project officer in arranging for the lease of this facility when ARO moved from Arlington Hall Station, Va., in May 1962.

Col Rosen served with HQ U.S. Army Element, Supreme Headquarters Allied Powers Europe (SHAPE) from July 1966 to June 1969, after graduating from the Army War College, Carlisle Barracks, Pa. He was assigned to the Office of the Assistant Chief of Staff for Force Development, HQ DA (1964–65) following a year as commander, 13th Engineer Battalion, 7th Infantry Division in Korea.

During a 4-year assignment with the Army Research Office-Washington (1959–63), he served successively as a staff officer on the tropical research program in the Environmental Sciences Division (also as acting deputy chief), chief of the Research Programs Office, and (additional duty) assistant executive.

For five months, in 1962, he was detailed as military assistant to the Deputy Director of Defense Research and Engineering (Administration and Management) for a special project. He also was staff assistant to the Army member, Coordinating Committee on Science, and research director of Autoprobe Task No. 2.

Col Rosen is a 1947 graduate of the U.S. Military Academy, commissioned in the Army Corps of Engineers, and has served in construction projects of Guam, Japan and Alaska in addition to Korea and Vietnam. He was awarded the Silver Star for action in the Chosin Reservoir in Korea while attached to the 1st Marine Division.

Human Relations Program Probes Thought, Behavior

Motivating factors in their behavior and thought processes have been studied by more than 700 managers and supervisors in a 12-hour Human Relations Training Program conducted at Aberdeen Proving Ground.

Aimed to improve understanding of reasons for thoughts and feelings of students with regard to new ideas, policies, individuals and groups, the training was directed by the APG Equal Employment Opportunity Officer, George H. Baker Jr., assisted by the Civilian Personnel Division.

Reasons for utilizing human relations to promote "genuine communication" and to make enrollees more aware of race relations in the United States were discussed. Trainees were encouraged to devote intensive thought to their behavior, attitudes, prejudices and unconscious discriminatory practices, and to engage in frank expression of viewpoints.

They had an opportunity to measure themselves, from the standpoint of their belief systems, and to evaluate their attitudes in the light of the real meaning of their scores on tests.

Dr. Wallace W. Culver, chairman, Department of Sociology, Montgomery Community College, Takoma Park, Md., conducted the training. He has been a consultant in social psychology to various U.S. Government agencies, including the Civil Service Commission and Department of the Army.

Army Deputy Surgeon General Gets Second Star

Army Deputy Surgeon General Spurgeon Neel was promoted to 2-star rank June 1, 20 months after he achieved general rank upon return from a second tour in Vietnam.

General Neel is a graduate of Memphis State University with a medical degree from the University of Tennessee and a master's degree in public health from Harvard University.

His service record shows duty as an instructor at the Army's Medical Field Service School, the Army Aviation School, and the U.S. Air Force School of Aviation Medicine; three years in Europe as a surgeon in World War II; 16 months in Korea during that war; surgeon of the U.S. Military Assistance Command, Vietnam (first tour) and CG, 44th Medical Brigade and surgeon, U.S. Army Vietnam (second tour).

A Fellow of the American College of Physicians and a Diplomate of the American Board of Preventive Medicine (in Aviation Medicine), he is also a Fellow and past vice president of the American College of Preventive Medicine, and a member of the American Medical Association.

As an Army physician, General Neel has received more than 30 personal decorations, including the Distinguished Service Medal, the Legion of Merit (four times), and Bronze Star.

Kudos

CHIEF OF R&D Lt Gen A. W. Betts presents Meritorious Civilian Service Award to engineer Richard L. Ballard.

MERITORIOUS CIVILIAN SERVICE. *Richard L. Ballard* received the Meritorious Civilian Service Award (MCSA) for his 9-year performance as an aerospace engineer with the Physical and Engineering Sciences Division, U.S. Army Research Office, Office of the Chief of Research and Development, HQ DA, January 1960 to October 1969.

His citation states that he "established an exceedingly well-planned, balanced and coordinated program of research and exploratory development in aeronautics and aerodynamics.

"His unfailing and conscientious devotion to duty, initiative, technical competence and great ability as a planner, organizer and manager have significantly enhanced the prestige of the U.S. Army and are a credit to him and to the Office of the Chief of Research and Development."

Woodland G. Shockley was presented the MCSA for achievements as chief of the Mobility and Environmental Division, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss.

The award citation credits him with "an outstanding contribution to the conduct of research, resulting in many useful products for the solution of military problems in vehicle design . . . and a more complete understanding of the effects of the environment on military activities."

Shockley was a member of a team of soil mechanics experts sent by the Chief of Engineers (1961–62) to inspect earthwork at intercontinental ballistic missile construction areas, serving as team chief the second year. He was a member of the Building Research Advisory Board's Technical Studies Advisory Committee to the Federal Housing Administration (1957–68) and was named to its executive committee in 1967.

In March 1966, he participated in a conference on "Lunar Soil Mechanics from the Apollo Viewpoint," and has represented the Corps of Engineers at international meetings in Canada and England.

Edward J. Morrissey received the MCSA for demonstrating professional and personal attributes in performing duties as visual information officer in the Office of the Chief of Research and Development from Mar. 6, 1960 to Apr. 15, 1970.

He was cited for his vast experience, technical expertise and devotion to duty which have contributed greatly to the portrayal of the Army R&D program in presentations before Congress, government agencies, industry groups and the public. He retired from government service in May.

LEGION OF MERIT. *Lt Col Fred R. Miller*, upon retirement from the Army with 25 years of service, received the LOM for "demonstrating the highest degree of initiative, organizational ability and resourcefulness" as a special project officer for the Mallard Project.

The citation states that he "demonstrated inspiring leadership and an outstanding appreciation of the principles of joint service coordination and interrelationships of all United States and foreign nation staff agencies participating in the Mallard development project."

Brig Gen Thomas J. Whelan Jr., special assistant to the Surgeon General for Medical Corps Affairs, recently presented the LOM to:

Col William H. Hayes, executive officer to the comptroller, for outstanding service with the Office for the Civilian Health and Medical Program of the Uniformed Services from August 1963 to August 1969.

Col Garrison Rapmund, chief, Medical Research Division, U.S. Army Medical R&D Command, for outstanding service as CO of the Medical Research Unit in Kuala Lumpur.

Col June F. Williams, chief, Army Medical Specialist Corps, for 3½ years of achievement as assistant chief of the Corps and chief, Dietitian Section.

Col Virginia N. Brice, AMSC assistant chief and Dietitian Section chief, for highly successful operation of the Food Service Division at Letterman General Hospital (1965–69).

Recent recipients of the LOM at HQ U.S. Army Missile Command (MICOM), Redstone Arsenal, Ala., include:

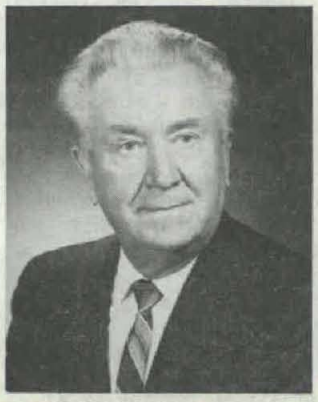
Col Mac D. Hendricks, for outstanding service as deputy director, Arsenal Support Operations Directorate and acting chief, DASO Control Office. *Lt Col David C. Rogers*, assigned to the Future Missile Systems Division, R&E Directorate, for distinguishing himself in Vietnam. Brig Gen George H. McBride, MICOM deputy CG, presented the awards.

Maj Gen Edwin I. Donley, MICOM CG, presented the LOM to Col Vernon V. Wallis, chief of the Personnel and Training Office, for previous service "in positions of great responsibility, culminating as assistant chief of staff, G1, U.S. Army Training Center, Infantry, Fort Polk, La., October 1968 to December 1969."

IEEE Nominates Egli Among 'Engineers of Distinction'

The 1970 inaugural edition of the Engineers Joint Council publication *Engineers of Distinction* will include the name of John J. Egli, an employe of the U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J.

Organized to advance the art and science of engineering, the Engineers Joint Council is composed of 39 engineering societies. The Institute of Electrical and Electronics Engineers (IEEE) nominated Egli and 139 other members as "Engineers of Distinction" from its membership of 162,000.



John J. Egli

Egli won IEEE's Harry Diamond Award for government employes in 1966 and was made an IEEE Fellow in 1967 for contributions to wave propagation, electromagnetic compatibility and advanced radio communications. In 1964 he won one of the top 20 civilian awards for papers presented at the Army Science Conference at West Point.

Employed at ECOM since 1941, Egli is currently serving as chief of the Electromagnetic Compatibility Area in the Automatic Data Processing Laboratory. He holds degrees in electrical engineering from Cooper Union and New York University and has done graduate work at Rutgers University.

From 1965 to 1967, he was chairman of the IEEE Electromagnetic Compatibility Professional Group, following a year as treasurer.

BRONZE STAR MEDAL. Two Vietnam veterans who recently returned to the Office of the Army Surgeon General, Washington, D.C., were awarded BSMs by Brig Gen Thomas J. Whelan Jr., assistant to the Surgeon General for Medical Corps Affairs.

Maj Edward M. Colbach Jr., assistant psychiatric consultant in the Directorate of Professional Service, received the BSM for his work in preventing and treating psychiatric casualties. *Capt John Miller*, special projects officer in the Directorate of Personnel and Training, received the BSM for service as an information officer with the 44th Medical Brigade.

ARMY MERITORIOUS SERVICE MEDAL. *Maj Robert G. Black*, career planning officer for the Medical Service Corps, received the MSM for performance as chief, Officer Branch, Personnel Division, Brooke Army Medical Center in Houston, Tex., December 1967 to November 1969. He also has served at Walter Reed General Hospital, Kimbrough Army Hospital, 6th Convalescent Center and 43d Medical Group in Vietnam.

JOINT SERVICE CM. *Lt James H. Billiter* received the Joint Service Commendation Medal for exceptionally meritorious service with the U.S. Project Management Office, International Mallard Project. Col Lester Tate, Mallard deputy program/project manager, made the presentation.

COMMENDATIONS, Office of the Chief of R&D, HQ DA. Certificates for Outstanding Performance Ratings were awarded recently as follows:

Office, Chief of R&D. Pauline Dorman and Thelda Davis.

Director of Plans and Programs. Mrs. Frances L. Jones, Miss Sandra C. Fidler and Robert S. Williamson (the latter with cash award for Sustained Superior Performance).

Director of Missiles and Space. Mrs. Bernice M. Greene, Mrs. Edna T. Jernigan and Mrs. Edith V. Johnson, OPR with Quality Step Increase; Mrs. Maxine H. Hutchinson, OPR with Sustained Superior Performance Award; Miss Erma R. Blamble, Commendation Certificate and Quality Step Increase; Mrs. Kathleen E. Ayotte, Commendation Certificate for Sustained Superior Performance.

Technical and Industrial Liaison Office. Miss B. A. Glea Lassen.

Information Systems Office. OPR Certificates to Mrs. Frances R. Belles, Spence T. Marks, Martin H. Weik. Mrs. Thelma F. Heisler received a Certificate of Achievement.

Director of Army Research. OPR Certificates to Dr. Leo Alpert, Mrs. Alice C. Arnold, Jacob L. Barber, Dr. James I. Bryant, Mrs. Jo Ann Cupp, Robert E. Daly, Mrs. Donna L. Fields, Fred Frishman, Dr. Ivan R. Hershner, Mrs. Jeanette H. Merritt, Mrs. Maria R. Murphy, Mrs. Janice B. Sexton, Earl A. Shepard, Dr. Eugene M. Sporn, Mrs. Ruthe I. Vaughn, Mrs. Cora F. Watson, Dr. Robert B. Watson and Mrs. Frances L. Whedon.

AVSCOM Holds First Bunker Memorial Science Fair

FIRST WILLIAM B. BUNKER AWARD WINNERS pose with Mrs. Bunker at HQ U.S. Army Aviation Systems Command. From left are Georgiann M. Kovacich, Mrs. Bunker, Paul A. Hemphill and Bruce W. Weathers.

In the Army Aviation System Command's first annual William B. Bunker Memorial Science Fair, named for the U.S. Army Materiel Command deputy commanding general who died in June 1969, an exhibit titled "Forming Ice Crystals in a Supercooled Cloud" won top prize.

Paul A. Hemphill, a Hazelwood High School student in St. Louis, Mo., where the fair was held, was awarded a $500 U.S. Savings Bond. He also will have his name engraved on a trophy that will go each year to the high school of the first-place exhibitor.

Second place, consisting of a $300 bond, went to Georgiann M. Kovacich, Cor Jesu Academy, for her exhibit "Mathematics in the Universe." A $100 bond went to third-place winner Bruce W. Weathers, Wilson High School, for "Effect on Flight Characteristics of Wing and Weight Variations."

Prizes were awarded by Mrs. Bunker, with each of the 10 entries receiving a bronze medallion bearing a profile of General William B. Bunker, who headed the Army Aviation Systems Command prior to assignment to the Materiel Command.

Guests at a banquet honoring the competing science students included parents, principals of St. Louis high schools, and presidents of organizations that sponsored the science fair. These are the Army Aviation Association of America, Association of the U.S. Army, American Helicopter Association, American Institute of Aeronautics and Astronautics, Armed Forces Management Association, and Missouri Society of Professional Engineers.

Maj Gen John L. Klingenhagen AVSCOM commander, was luncheon speaker; Lt Col Dean Wright, chairman for the fair, was toastmaster.

When Is a Beetle Not a Beetle?

When Scientific Accuracy Runs Afoul of Editorial Policy

Scientific accuracy is a fetish with many of our readers, a characteristic that sometimes runs afoul of an established editorial policy of trying to use layman's language rather than strictly technical terminology.

In the eyes of the layman, it was proper to use the term beetles in a page one article in the February 1970 edition of the *Army Research and Development Newsmagazine* to report on a significant discovery of Army researchers regarding Chagas' disease.

Capt Jerrold J. Feldner, stationed at Fort Gulick in the Panama Canal Zone, pointed out that, in his opinion, beetles is not correct—although a beetle is, by the dictionary, "any of various insects more or less resembling those of the order *Coleoptera*."

His May 11 letter follows:

Dear Mr. Editor,

In reference to your article on Chagas' disease in the February 1970 issue, I believe there is an error. If I remember my entomology correctly, the triatomid vectors of Chagas' disease are, in fact, true bugs of the order *Hemiptera* and not beetles as was stated several times in the article. As far as I know, all vectors for Chagas' disease are concentrated among the triatomid family, for instance, the so-called "kissing bug" which carries the disease in northwest Mexico and into the central valleys of California.

This is a small thing but I think it merits your attention in upholding the obviously high standards of your fine publication.

Electro-Polymerization: A New Photographic Technique

By Harvey A. Hodes

Much research effort has been devoted to supplanting conventional silver halide photography, especially in military applications. One such effort, pursued in Electronics Command Laboratories for the past three years, depends on electrically initiated polymerization as a means of image formation.

The heart of the system is a sandwich structure consisting of a high gain photoconductive layer, a polymerizable monomer layer, and a conductive metal support. Light rays, or an image-wise exposure pattern, falling on the photoconductive layer generate a flow of electrons through the sandwich. This electron flow causes image-wise polymerization of the monomer layer.

Minimum processing is involved, consisting mainly of a short dip in hydrogen peroxide and immersion in dye to make a stable, permanent image.

Actually the sandwich structure is a straightforward electrolytic cell—the photoconductive layer forming one electrode, and the conducting support the other, with the monomer electrolyte between. Almost all the reactions normally occurring at the electrodes of a conventional cell can be made to occur in this sandwich structure. Indeed, anodic oxidation, cathodic reduction, ion migration and Ph change are, in one form or another, the basis for the polymerization reactions.

An image-forming polymerization reaction will further illustrate the anology between photo-electrolytic imaging and ordinary electrolysis. The image-recording layer is coated on a metal substrate, usually stainless steel, which forms the anode. The photoconductive layer is the cathode. On electrolysis the anode is partially oxidized and ferric ions are injected into the image layer.

A reducing agent in the emulsion then reduces the iron to a lower valance state. The development step consists of immersing this emulsion layer in dilute hydrogen peroxide for a few seconds, during which image-wise polymerization occurs.

The unreacted portion of the emulsion layer is next washed away in warm water, and the image made more visible by immersion in dye. The following equations explain these reactions more explicity.

(1) $Fe \longrightarrow Fe^{+3} + 3e$

(2) $Fe^{+3} + R \longrightarrow Fe^{+2} + (R)+$

(3) $Fe^{+2} + H_2O_2 \rightarrow Fe^{+3} + HO^- + HO.$

In the photo-optics technical area at the U.S. Army Electronics Command, Fort Monmouth, N.J., Harvey A. Hodes is project engineer on photopolymer imaging systems and for development of ultra sensitive photo conductive devices. His current project in electro-polymerization has resulted in authorship or co-authorship of five technical publications and thirteen patent applications, two of which have been granted. The author received a BS degree in chemistry from Syracuse University in 1942 and has done graduate work at Columbia University and the Massachusetts Institute of Technology.

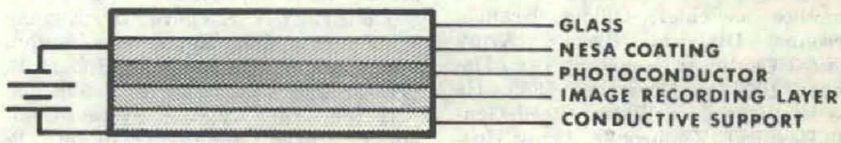


Fig. 1. Diagram of Sandwich Structure

Equation 1 is simply the anodic oxidation of the steel electrode to produce ferric ions. Equation 2 is the reduction with a reducing agent (R), such as ascorbic acid or dipenylcarbazide, to the ferrous state. Equation 3 is the development step, the reaction of ferrous ion with hydrogen peroxide to produce free radicals and intiate polymerization.

Chemically oriented researchers will recognize equation 3 as the classic redox reaction to produce free radicals. The method of generating these free radicals, electrolytically, in image-wise fashion, is the unique feature of this project.

The type of polymerization employed—vinyl addition—depends on the production of free radicals for initiation and growth of the polymer chain. The equations demonstrate that as long as current flows through the cell, free radicals will be generated. This is an important source of photographic amplification in the image-forming process.

Another important source of amplification is the photo-conductive layer itself. Cadmium sulfide and cadmium sulfo-selenide have been used almost exclusively. Zinc oxide, investigated briefly, was abandoned because of slow light response and lack of quantum gain.

Large area sintered photoconductive layers have been developed with quantum gains as high as 10^4. This means simply that for each photon adsorbed, about 10,000 electrons are available for the polymerization reactions—representing considerable amplification in the complete imaging system.

The following illustrations demonstrate the technique of obtaining images, and the present state-of-the-art. For reference, the usual diagram of a sandwich structure is shown in Fig. 1. The diagram shows the photoconductive layer deposited on Nesa glass, which is glass coated with a transparent conductive coating.

The photoconductive layer, the conductive support and the image-recording layer form the electrolytic cell already described. Potential applied to this sandwich ranges from 70 to 180 volts, depending on length of exposure and level of illumination.

A more realistic illustration is that of the imaging set up shown in Fig. 2. Here we have the actual photoconductor, the steel substrate coated with the monomer composition, the clamp needed to hold the parts together, and an image obtained by this technique.

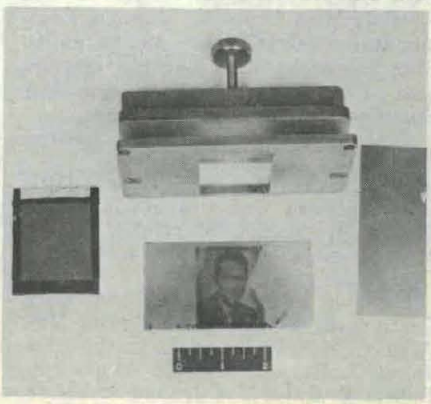


Fig. 2. Component Parts of Sandwich

The photoconductive layer is about 8 mils thick; the monomer coating about 1–2 mils thick.

For uniform electrical contact, a wet junction is required, consisting of a few drops of water containing sodium or potassium chloride. The moistened halves of the sandwich are pressed together and clamped into the support bracket.

The complete imaging system presently used in our investigation is shown in Fig. 3. The scope is useful in following the course of the electrolysis reaction. The direct current power supply is from ordinary batteries and an electric timer is used for exposure control. The sandwich, already described in detail, is mounted on the optical bench.

When an image from the projector is focused on the photoconductive layer, and an electrical potential is applied across the sandwich, an image-wise conductivity pattern is formed. Current, proportional to the image pattern, then flows through the image-recorder layer. This image-wise flow of current is responsible for the polymerization reaction.

Unlike conventional photography, which requires an optical shutter, electro-polymerization system can be made either light-operative or current-operative—that is, exposure can be made while an electrical potential is applied, and illumination is admitted through a timed shutter. Illumination can be continuous, and a timed electrical potential applied; for convenience, we use an electric timer.

Exposure in electro-sensitive imaging is determined not only by illumination and time, but also by the electric field applied across the sandwich structure. For example, with 130 foot candles illumination, the same effect is obtained in 0.10 seconds with 22.5 volts as is in 0.01 seconds at 45 volts. Doubling the applied voltage has thus decreased the exposure time by a factor of 10. This is a convenient method of increasing overall sensitivity, not available in conventional photography at present.

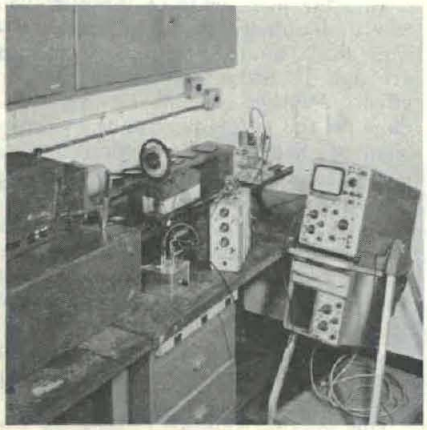


Fig. 3. Complete Imaging System

Fig. 4 is a reproduction of an image made with the materials and the electro-polymerization procedure. The most obvious defect is poor resolution. Continuous tone is surprisingly good, and contrast is satisfactory. The gray area around the border is caused by uneven contact between the emulsion and the photoconductor. Speed is equivalent to an A.S.A. rating of 8. The over-all picture quality is average for the present state-of-the-art.

Fig. 4. Image by Electro-polymerization

Army Installs CRFS Aboard Iroquois Helicopters

A Crash-Resistant Fuel System (CRFS) has been installed aboard the first of the Army's fleet of Huey Iroquois helicopters with the forecast of preventing the deaths caused by fire after the crash by a factor of more than 70 percent.

A rubber-and-fabric fuel tank is the heart of the system which is capable of withstanding the impact of crashes more severe than humans can survive. Therefore, the CRFS sharply reduces the danger of fire caused by fuel escaping from ruptured tanks, fittings or fuel lines.

The life-saving potential of CRFS was detailed in an Army study which reveals that, over the past three years, its planes were involved in 334 accidents, of which 206 were survivable—except for the fact that the planes caught fire. Fatalities in these post-crash fires totaled 155, while an additional 470 men suffered burns.

Had these aircraft been equipped with the new fuel system, the Army said, deaths would have dropped from 155 to 44, or 72 percent. Burn injuries would have been reduced from 470 to 132, and losses in aircraft and materials would have been cut from $80 million to $22 million.

The Army, which has more Huey Iroquois in service than any other type of aircraft, plans to install the system in all existing craft of this type, and by 1975 hopes to have selected rotor- and fixed-wing aircraft equipped with CRFS.

The new fuel system was developed under a $2-million program funded by the Army. Taking part were Goodyear Tire and Rubber Co., Bell Helicopter Co., and the Dynamic Science Division of Marshall Industries, Phoenix, Ariz., under contract to the Army Aviation Materiel Laboratories, Fort Eustis, Va.

Goodyear's Aviation Products Division holds the first multimillion-dollar contract to supply the flexible-type fuel tanks which will ultimately be utilized in all Iroquois aircraft. Each craft uses a series of these ARM tanks—so named to signify the type of armor or protection used. The ARM tanks are manufactured at Goodyear Aerospace Corp. facilities at Litchfield Park, Ariz.

AVSCOM Employe's Ingenuity Gets Disabled Copter to Safety

Ingenuity in the use of a wine bottle cork to plug a bullet hole in a combat-riddled $2 million Chinook aircraft, enabling it to be flown to a safety area, is one of the interesting recent Vietnam vignettes.

As reported by the U.S. Army Aviation Systems Command at St. Louis, Mo., the "Super C" Chinook had reached the landing zone with the number two engine totally disabled and a hole in the transmission case.

AVSCOM field representative Alfred G. Reese, after being informed by a maintenance crew that extensive repairs would be necessary before the aircraft could be flown, decided it could be moved—rather than left to advancing enemy forces as night was closing in—if the bullet hole in the transmission could be plugged.

The cork from the wine bottle was found near the perimeter of the field and pressed into emergency service. Reese reportedly held the cork in place, despite the hot seeping oil, until the aircraft reached a safe area.

Mixing Metals in Space Proposed

National Aeronautics and Space Administration (NASA) scientists are experimenting to determine whether some metals can be processed more effectively in the zero-gravity of space than on earth.

Some materials made of two constituents which melt at different temperatures are difficult to mix on earth. The experiment is being developed for the manned orbiting workship NASA plans to launch in 1972.

Betts Gives Section 203 Views to AFIP Board

(*Continued from page 2*)

Dr. Weiss asked how he managed to keep abreast of the activity in his field. The biophysicist thereupon produced five publications. "Are those abstract journals?," asked Dr. Weiss. No, these were *title indices*—the point being, he explained, the material has become so voluminous that the scientific journal gave way to the abstract journal, which in turn has given way to the title index.

Under such conditions, how could one possibly expect titles of small research efforts to reflect military relevancy? (Italics added.)

Actually, there is still another question. Basic research, by definition, seeks simply to acquire new knowledge. The possible application of this knowledge is yet another step away. Can it, then, be said to have a "direct and apparent relationship to a specific military operation?"

My answer is, I believe it can. Any research effort of quality in a technology that is used in military applications must inevitably contribute to improvements in that technology. Surely that is a "direct and apparent relationship."

This leads logically to the question, "Why cannot all federally funded basic research be supported by the National Science Foundation?" Obviously, it could, if the NSF had adequate funding, but would it make sense?

I think not. It is most important that our involvement in support of research be a 2-way street. To get the best possible return on the resources we put into research, the dialogue between the investigators and those who know why the research should be supported must be direct and frequent.

The question is academic, at the moment, because the NSF, too, is suffering budget problems. In FY 70, it received an appropriation of $440 million for all purposes, fellowships and traineeships as well as research. This was $57 million less than it had requested; obviously, NSF funding is inadequate.

But that begs the question. It is perfectly clear that of all of the federal agencies supporting research, only the National Science Foundation does not have an operational mission. All of the others, whether it be the National Institutes of Health, Department of Agriculture, Department of Transportation, and so on, have missions to which their research efforts must contribute.

As I understand the tenor of Congress, we are likely to see more and more emphasis on mission relevancy if research is to get the support it deserves. It used to be that we had to show relevancy only to middle management. The rules of the game have changed; today's Congressman is more apt to have a legal background than any other, and he likes to see hard evidence—some proof of relevancy.

But, as I have indicated, the question of relevancy is not as easily demonstrated as some would like it. The words in Section 203, "direct and apparent relationship," do not answer the important question: Apparent to whom?

Deputy Secretary of Defense Packard, I understand, has said that the National Academy of Sciences had been invited to consider carrying out a review of those projects and studies within the DoD research program that might be regarded as marginal under the provisions of Section 203. The Academy replied, according to one source, that it is the "academy's position to assume that no one knows better than the Department of Defense what is relevant to defense."

Just what has been the impact to date of Section 203 on the Army's research program? Actually, the effect on the 1970 work program has been very minor as regards cancelling any work that we were supporting. The fact of the matter is that our own review processes have been quite demanding.

As a matter of policy, we support only those research programs that meet our standards of quality and relevancy to particular Military Themes. A military theme might be: research for night vision, or simply corrosion.

As a result, under a fairly stringent interpretation of direct and apparent relevance, less than one percent of our 6.1 research projects failed to meet the requirement for "direct and apparent relationship" of Section 203. This is less than the number of projects we normally weed out as nonproductive every year.

Are we crying, "Wolf," then? I think not. There is a clear and demonstrable danger latent in this Amendment as it now stands. First off, a very strict interpretation poses a very real possibility that potentially excellent scientific research effort may fail of support simply because the payoff is not foreseen when the proposal is evaluated.

For example, there is the work performed by Dr. G. H. Dieke, of Johns Hopkins University, on Spectroscopic Studies in Gas Discharges. It does not sound very military, does it? But, this was Army-funded research. Dr. Dieke was investigating the spectroscopy of helium and neon gas discharges and also the spectrum of rare earth ions. I doubt that this research could have satisfied a very strict interpretation of Section 203 either in the proposal stage or while underway.

Once the laser was invented, however, the results from this work contributed directly to the development of solid-state and gas lasers. Only then did the direct military relevance of this work become obvious.

Laser rangefinders and target illuminators used by the Armed Forces today depend on and would probably not be available without the work done by Dr. Dieke at a time when relevancy would have been difficult, if not impossible, to demonstrate.

Another example: The Army supported Dr. A. V. Tobolsky of Princeton University in his work on High Polymer Chemistry between 1954 and 1960. Dr. Tobolsky was seeking a new kinetic approach to the mechanism of polymerization. Several papers concerning results of his investigations were published during this period.

During the evaluation of the professor's renewal proposal in 1960, one Army laboratory evaluator stated that "relevancy is lacking," and still another rated the project as "unknown with respect to applicability." Under Section 203, we would have had to drop Prof. Tobolsky's work.

As it turned out, the Thiokol Corp., with Dr. Tobolsky as a consultant, developed a new solid-propellant binder that was based on Tobolsky's earlier work. Since then, Thiokol and others have been manufacturing this and similar binders—binders purchased by the millions of pounds by the Military Services for missiles.

In your own fields of interest, you can undoubtedly recall similar projects that would not have come to fruition if Section 203 had been in effect. Another example is the work done on the guidelines for the protection of hearing—work that in its early stage would have had no direct and apparent application.

Even the work on metabolic studies of red blood cells could have been challenged under Section 203, so that our life-saving advance in improved storage life of whole blood might still be unknown. Civilian urgency for long storage periods is not as great as it is for the military.

One might well ask: Why is the Army doing research in malaria? This disease no longer is a problem in

the United States. In the Pacific Theater of Operations we have drugs that did a pretty good job of controlling it in the last war. If work needs to be done, why can't it be done by the National Institutes of Health or by private institutions?

This audience knows the answer, but there are many who do not realize that malaria is still a very serious problem to U.S. forces in Southeast Asia. Drugs that were formerly effective in combatting this disease are no longer doing the job. Since malaria is not an urgent problem to the U.S. civilian population, it would take a low priority in competition for resources in civilian medical research. Relevancy here is obvious.

I suspect that a strict interpretation of Section 203 would have prevented our support of Dr. Macfarlane's work on the aborigines of Australia and New Guinea. By comparing two groups at similar cultural levels, he sought to isolate factors leading to adjustment to the hot-dry climate of central Australia and the hot-humid climate of New Guinea.

The major factor was found to be dietary. Such information is of great value to our military forces whose units may be called upon to move literally over night from our temperate climate to one totally different. A means of rapid acclimatization to a foreign environment will enhance their effectiveness. Relevancy then becomes apparent.

Many other examples could be cited to reinforce our concern about the dangerous implications latent in this Amendment. Secretary of Defense Laird expressed it as follows:

"If Section 203 means that every researcher must declare in advance some military application to his effort in order to obtain defense funding, this would tend to discourage talented scientists from potentially productive research areas . . . . We must not cripple either the productive industrial base or the vigorous industrial and academic research base which has evolved over the years. We cannot settle for anything short of technological leadership in research and development."

Secretary Laird also emphasized that President Nixon believes that to achieve peace with security the United States must remain in the forefront of advancing technology. As Mr. Laird put it, "We must keep abreast of technical advances that could magnify the effectiveness of our weapons and forces. This is all the more important in a period of tightening budget limitations."

Dr. John S. Foster, Secretary Laird's Director of Defense Research and Engineering, recently pointed out still another aspect of the necessity of maintaining a virile, responsive research and development effort—not only a military effort, but an equally effective civilian one. This aspect is the rapidly rising challenge to America's technological leadership from abroad.

"The trend is grim," said Dr. Foster, "grim because we Amercans have enjoyed a well-founded confidence in our ability to meet any challenge in defense, in atomic energy and in space . . . . So long as we had clear technological leadership, there was small risk that we might one day be confronted with a major surprise in weapons."

If we fall behind the Soviets, who are already surpassing us in level of effort in many areas, he pointed out, then the task of estimating what is happening behind their cloud of secrecy will be much more difficult and risky.

In the present climate, we must recognize that a better correlation will be required in the allocation of research resources to the most potentially useful area of application. We will probably receive adequate funds —not abundant, but adequate, provided we use them wisely.

As Dr. Foster pointed out, through the revitalization of the National Security Council, there will be a clarification of U.S. priorities and foreign policies, and the "country's research and development program will increasingly reflect this searching reorder of priorities."

This nation, he declared, must maintain technological leadership and adequate national security for the long-range future—"We must spend now at substantial levels on basic and applied research. . . . To default on technical leadership will be to accept ever greater risks to our national security. Without this security, all else is theoretical musing or vain hope."

Against this background, the present wording of Section 203 of the FY 70 Authorization Act seems out of place, and I would hope for a change to the restrictiveness imposed by this amendment.

USAEPG Selects Dr. Schafer as Technical Director

Dr. George E. Schafer is the new chief scientist/technical director of the U.S. Army Electronic Proving Ground (USAEPG) at Fort Huachuca, Ariz.

Dr. Schafer's responsibilities will include advising the Electronic Proving Ground commander on scientific and technical matters, professional development programs for scientific and technical personnel, and maintaining liaison with the scientific and academic communities.

Prior to joining the USAEPG staff, he worked nine years with the National Bureau of Standards at Boulder, Colo., specializing in research in microwave attenuation, microwave phase shift, and microwave field strength measurements. In January 1969 he was named chief of the Bureau's Microwave Standards Section.

Born in Lincoln, Neb., he received a BS degree in physics from Macalester College, St. Paul, Minn., in 1943, an MS in physics from the University of Minnesota in 1949, and a PhD in physics from the University of Colorado in 1968.

Dr. Schafer is a member of the American Physical Society, the Research Society of America (RESA), the U.S. Commission 1 of the International Scientific Radio Union (URSI), and is a senior member of the Institute of Electrical and Electronics Engineers (IEEE).

Among his numerous honors and awards are the Petroleum Research Fund Fellowship, the Department of Commerce's Certificate of Award, Meritorious Service Honor Award, Silver Medal for Meritorious Service, and the Bureau of Standard's Outstanding Paper Award for a technical paper. In 1964, he was selected to participate in the Department of Commerce Science and Technology Fellowship Program.

Dr. George E. Schafer

CE Names 2 District Engineers

Two Army Lt Cols have been named district engineers in the North Central Division of the Corp of Engineers.

Lt Col James M. Miller will become district engineer of Lake Survey District, Detroit, Michigan and Lt Col Myron D. Snoke will become district engineer at Detroit, Michigan.

Conference Accents Growing Criticality of Operations Reasearch

(*Continued from page 4*)
manner in which the data is captured, structured, managed and applied will be the key to how effectively the computer systems of tomorrow can operate.

"Apart from the computer manufacturers, many of the challenges I have outlined will be faced and met by those of you here in this room tonight—those of you who work with the computers as users, operate the computer installations, and provide important services to your establishments and organizations. You have the role to play, and I am sure that you 'OR' people, with your inquisitive natures and open minds, will pick up this challenge and carry it effectively right on through the seventies."

ARMY DIRECTOR OF RESEARCH Brig Gen George M. Snead Jr. presided as symposium chairman and toastmaster at the banquet in addition to making the opening remarks. Lt Col Edgar G. Hickson Jr., acting commander of the Army Research Office-Durham, welcomed conferees.

Pinchhitting for Deputy Under Secretary of the Army (Operations Research) Dr. Wilbur Payne, his chief, Dr. Daniel Willard gave an address and moderated a panel on "Model Construction and Simulation." He defined simulation as "argument by analogy," models as "data transformers" or "data generalizers," and said much data is in search of a model."

Dr. Willard cited the flight of Apollo 13 and the landing on the moon as an outstanding example of the simulation process and a logical progression to assurance of success. Simulation can be simple or complex, he said, ranging from data filling the most powerful computers to calculations and analysis on the back of an envelope.

One of the questions in a lively discussion following Dr. Willard's introduction of the subject, in which Chief of R&D Lt Gen Betts and other top-ranking leaders participated, involved the validity of the design of models: How do you convince the decision-makers that a model (analytical or otherwise) is a valid basis for consideration of an important system?"

Dr. Willard's answer was, "We must come up with measures that are meaningful to the decision-maker. The OR analysis should give the D-M understanding of critical factors."

Ensuing discussion brought out that the decision-maker must gain an understanding of the variables involved" . . . that operations research is an analytical tool to use for optimization of objectives, with consideration of psychological and other human factors pertinent to the problem. Rapport between the analyst and the decision-maker was termed essential."

PANEL ON LOGISTICS SIMULATION. Maj Gen F. J. Gerace, Director, Requirements and Procurements, Army Materiel Command (AMC), moderated a controversial discussion on this topic.

Panel members included Dr. R. P. Uhlig, Directorate of Management Information Systems, AMC; Douglas E. Smith and Howard Markham, Research Analysis Corp.; and Alan Kaplan, Inventory Research Office, AMC.

General Gerace said that as a decision-maker he has to come to grips with questions involving expenditures of about $5 billion annually, and that "any system that would help us to spend that money more wisely, for the right things, at the right time, would be appreciated."

Kaplan said that simulation "cannot be a black box, full of mystery. It must be solidly based on valid data, estimates and assumptions."

One of the problems stressed in simulating and modeling for optimal results is that testing of weapon systems and components often is done under "good conditions, not the adverse environment of field conditions."

Differing field conditions, such as in Europe, in Korea or in Vietnam, it was pointed out, result in a wide variation in demand for materiel and equipment replacement parts, making it difficult to model successfully an optimum requirement.

General Gerace held that, despite the variables and complexities involved in logistics simulation, well-conceived modeling can provide valuable assistance, particularly as more reliable field data are assembled. "We have only so much money to spend these days of budgetary constraints," he said, "and every economy helps."

REVIEW OF MODEL VALIDATION. One of the most spirited of the panel discussions, this was moderated by Dr. Leslie G. Callahan, long associated with Army R&D in key positions as an officer and now professor and coordinator for Army graduate students at the School of Industrial and Systems Engineering, Georgia Institute of Technology.

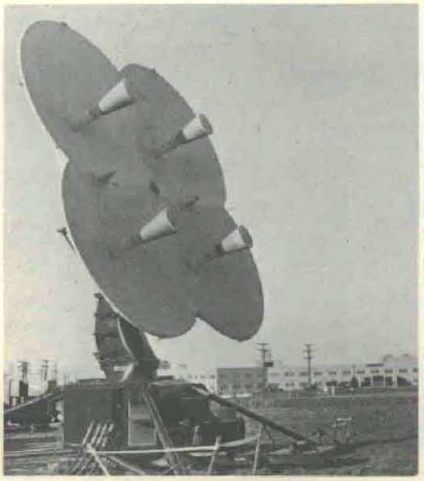
Presentations on the topic were made by Dr. Walter E. Sewell, Duke University, and Dr. George E. Nicholson, University of North Carolina. Col Louis F. Dixon, Office of the Assistant Chief of Staff for Force Development, Hq DA, presented "Force Development Management Information Systems" as relevant to the topic.

Dr. Sewell said pressures of the decision-making process in the Pentagon at top management level "force many to grasp at any straw that may be helpful to more knowledgeable and wisely productive decisions."

Validation of models for the decision-maker is exceedingly difficult in view of the variables and other complicating factors, Dr. Sewell said. "What we are looking for is *relative validation*. Those of us who are working in this field are well aware that there is a great deal to be done to achieve greatly improved standards of validation."

Dr. Nicholson commented that when models of a system or a part of a system are not adequately validated, "they tend to become theories."

Dr. Callahan said the real problem



AN/TSC-54, the Army's latest in satellite communications transmitter-receiver stations, recently was turned over to the U.S. Army Strategic Communications Command's (STRATCOM) 11th Signal Group for training purposes at Fort Huachuca, Ariz. Capable of handling both voice and teletype traffic over distances from 6 to 7,000 miles, the transportable terminal is linked to two identical units located at Tinker Air Force Base (AFB), Okla., and Brandywine AFB, Md., by satellites orbiting the earth at 23,000 miles in space. Designed for contingency use, the terminal will play an important part in STRATCOM's mission of providing communications anywhere on a moment's notice.

in OR modeling is to learn to use the techniques properly as invaluable tools, not toys. "A model," it was stated, "is an imperfect process of trying to understand better that which is exceedingly difficult to comprehend . . . Validation is an adaptive process."

Col Dixon detailed some of the problems of the interface for the "Force Planning Data Bank," involving highly complex variables in deciding the Army's personnel requirements in a world of rapidly changing situations. He cited the Chaparral and Vulcan weapon systems as being among prime examples of validating the results of operations research studies.

SIMULATION FOR LOW INTENSITY CONFLICT. William Lueders, Institute of Strategic and Stability Operations, Fort Bragg, N.C., chaired this discussion covering three variations of low intensity conflicts. Presentations were:

Dr. James A. Zwerneman, Research Triangle Institute, Durham, N.C., "Adaptive Simulation Model for Decision Making"; Louis Long, Advance Systems Laboratory, Mobility Equipment R&D Center, Fort Belvoir, "Border Security System"; and David R. Howes, Strategy and Tactics Analysis Group, Bethesda, Md., "Event-Sequenced Simulation of Guerrilla Hostilities."

In his summation of the symposium, Dr. Frank Grubbs, chief operations analyst, Aberdeen (Md.) R&D Center, commented on this panel discussion: "Since the activities and actions involved with low intensity conflict are so voluminous, with an infinite number of variables, it would be an almost impossible task to physically prepare or test for all possible contingencies. Therefore, simulation and modeling can be valuable assets for establishing guidelines for organizational concepts, doctrine, and materiel requirements for the commanders in the field. . . "

SIMULATION IN DESIGN OF SMALL ARMS. Col Charles B. Hazeltine Jr., commander, Institute of Systems Analysis, U.S. Army Combat Developments Command, chaired this discussion. Panelists and topics were:

S. D. Corbin and R. P. Marchi, Litton Scientific Support Laboratory, Fort Ord, Calif., "A Simulation Used in the Design of Small Arms Experiments"; Ray Rudolph, Falcon R&D Co., Cockeysville, Md., "Analytical Simulation of Helicopter Duels"; and Charles Allen, Research Analysis Corp., McLean, Va., "Simulation Techniques Used To Determine Optimum Mix of Transport Aircraft."

(The writer of this article did not have a chance to attend this concurrent session and no summation of the discussion was provided.)

ROYAL MILITARY COLLEGE OF SCIENCE. "The Use of War Games and Simulation to Determine Optimum Weapon Mix," by Prof. Ronald Shephard of the Royal Military College of Science in the United Kingdom, was expected to be one of the highlights of the symposium; and it more than fulfilled expectations.

Scheduled to provide a break in the series of panel discussions, this presentation detailed an interesting case history of a military operations research problem in England. Prof. Shephard pointed out that there is really no such thing as an "optimum weapon mix," and that "cost-effectiveness studies are useful and important only at higher military levels."

War games and simulation, he said, "provide the only known method of approach for predicting over-all effectiveness," and such techniques help in deciding the "best" weapon mix for brigades in a division, etc. The decision-maker always wants to and is trying to optimize the mix of weapons and allocation of resources, "but optimization is always only a goal of operations research because so many variables are involved that this is not practicable."

Prof. Shephard's presentation sparkled with reserved British humor.

TRANSPORTATION/COMMUNICATIONS NETWORKS. A panel discussion of simulation techniques used in this field was chaired by Col John P. Chandler, chief, Engineer Strategic Studies Group, Washington, D.C. Presentations included:

Capt James E. Weatherbee, Systems and Methods Branch, ESSG, Washington, D.C., "Interdiction—Lines of Communications (INTLOC)"; Miguel Carrio, ADP Lab, U.S. Program Office, Mallard Project, Fort Monmouth, N.J., "Mallard Simulation Model"; and William L. MacMurdy, Defense Intelligence Agency, Washington, D.C., "Automated System for Transportation Intelligence (ASTI)."

Dr. Grubbs' summation of this discussion states, in part: "The sheer size of the Mallard simulation systems may have inhibited a clear understanding of the goals and results. . . . A quantum jump in this area could greatly reduce programing and running time . . . and make simulation more useful . . . ."

Contributed Papers. Col J. B. Hughes, head of the Directorate of Evaluation, HQ U.S. Army Combat Developments Command, presided at a concurrent session featuring contributed papers. Authors and their subjects were:

First Lt Gerald W. McLaughlin, U.S. Military Academy, "The Application of Computer Simulation to a Three-Person, Non-Zero Sum Game"; Capt Frank Patitucci, Office of The Surgeon General, HQ DA, "A Competitive Bidding Model"; E. G. Peterson, O. J. Erickson and N. P. Wold, Deseret (Utah) Test Center, "Sensitivity Analysis of a Weapons Effect Simulation."

SIMULATION IN AIR MOBILITY. John Intlekofer, chief, Combat Support Division, Army Materiel Systems Analysis Agency, U.S. Army Aberdeen (Md.) R&D Center, organized and chaired a panel on the "Uses of Simulation in Air Mobility." Presentations were:

J. N. Fischer, chief, Operations Analysis, Bell Helicopter Co., "Utility Aircraft Mission Processor Model" and Francis Villa, Sikorsky Aircraft Co., "Simulation of Cargo Dispersal Systems."

Contributed Papers. In a concurrent session chaired by Col William H. Travis, Division of Military Applications, U.S. Atomic Energy Commission, technical papers were presented by:

Maj Kenneth C. Lingle, Capt Martin P. Wanielista and Capt John J. Wiorkowski, Office of The Surgeon General, HQ DA, "A Monte Carlo Simulation for Decision-Making in Military Hospitals"; Richard H. Gramann, Research Analysis Corp., "Combat Service Support Planning and Analysis"; and Lt Col Robert W. Blum, PhD, Combat Developments Command Institute of Systems Analysis, Fort Belvoir, Va., "A Perspective on the Use of Simulation in Decision-Making."

ALTERNATIVE MANPOWER/PERSONNEL POLICIES. Cecil D. Johnson, U.S. Army Behavior and Systems Research Laboratory (BESRL), Arlington, Va., organized and moderated a session on "Simulation Models for Evaluation of Alternative Manpower/Personnel Policies." His introductory topic was "What's Special About Manpower Models." Other presentations were:

Brig Gen (USA, Ret.) Paul D. Phillips and Mrs. Betty Holz, Research Analysis Corp., "Manpower Model for Comparing Alternative Manpower Programs"; Pauline Olson, BESRL, "Manpower Models—Allocation and Evaluation"; and George Nozicka, CEIR Division, CDC Corp., "U.S. Marine Corps Enlisted Population Model."

STANO SIMULATION. Providing a fascinating climax to the symposium was a discussion chaired by

(*Continued on page 58*)

Symposium Accents Criticality of Operations Research

(*Continued from page 57*)

Maj Gen John Norton, deputy director, Project MASSTER (Mobile Army Sensor Systems Test, Evaluation and Review), Fort Hood, Tex. Devoted to STANO (Surveillance, Target Acquisition and Night Observation) Simulation, this discussion obviously intrigued the audience.

General Norton detailed many of the complexities of Project MASSTER and the critical role operations research techniques of modeling and simulation is playing in accelerating development of this program, carrying top priority and direction from the Army Vice Chief of Staff.

Simply stated, General Norton said, the objective is to make American soldiers safer through electronic reconnaissance and to increase combat effectiveness through a greatly improved intelligence capability and an integrated area fire control system.

Indicative of the complexities involved, he explained, is that within less than six months of intensive effort, more than 250 new items of materiel components have gone into production, are going into production shortly, or are in the procession of decision-making regarding production.

Without effective modeling and simulation, he said, the present rate of project acceleration would not be feasible. OR techniques were credited with "reducing test time at every phase and sequence."

General Norton described many of the components that are being improved and new elements being developed for the STANO system. He described also the "battlefield of the future" as envisioned through STANO developments. In reiterating the criticality of effective modeling and simulation to the success of Project MASSTER, he said, "we earnestly solicit your support."

General Norton's panel included:

Lt Col G. E. Galloway, assistant systems manager, Office of the Chief of Staff, HQ DA; Lt Col H. W. Moye, chief, Automation Planning Group, Project MASSTER; M. A. Benanti, chief, Systems Methodology Division, Systems Cost Analysis Division, U.S. Army Electronics Command, Fort Monmouth, N.J.; and R. V. Attarian, chief, STANO Support Group, Institute of Systems Analysis, HQ Army Combat Developments Command.

Dr. Frank Grubbs, in his symposium summation, traced briefly the rapid growth in development of techniques and utilization of results of operations research. The U.S. Army pioneered, he said, in accentuating this emerging new science by sponsoring the first OR conference at the Office of Ordnance Research (now Army Research Office-Durham) in 1962.

Acknowledgements were made by Brig Gen Snead and Lt Col Hickson to the men whose planning and arrangements contributed to the success of the symposium. Dr. Marion Bryson, formerly with Duke University in Durham and now with HK U.S. Army Combat Developments Command, was technical adviser to the Chief of R&D for the symposium, a role in which he has served several years.

Maj Gerald R. Wetzel served as project officer for the Director of Army Research and was assisted by Maj Richard T. Detrio, adjutant of the Army Research Office, Washington, D.C. The "work horses" at Army Research Office-Durham included Maj W. E. Wooton, action adjutant, and John Jordan, administrative officer.

OCRD Entertainment Draws Exceptional VIP Attendance

Entertainment items seldom appear in the *Army Research and Development Newsmagazine*, except when they are somewhat historical in nature, as was the Office of Research and Development dinner, theater and dancing party June 6 with a large attendance of dignitaries.

"How to Succeed in Business Without Really Trying" provided the robust humor that "rocked" about 275 guests, extending to the maximum the capacity of the Burn Brae (Md.) dinner and theater club. This is believed a record turnout for any type of OCRD social event.

Dignitaries included Chief of R&D Lt Gen A. W. Betts; Deputy CRD Maj Gen Edward L. Rowny; Maj Gen Louis Metzger, HQ U.S. Marine Corps Deputy Chief of Staff for R&D and Studies; Maj Gen R. R. Williams, HQ DA Deputy Assistant Chief of Staff for Force Development; Maj Gen John R. Guthrie, Director of Research, Development and Engineering, Army Materiel Command; and

Dr. Marvin E. Lasser, Army Chief Scientist; Dr. Robert B. Dillaway, Army Materiel Command Director of Laboratories; Brig Gen Stewart C. Meyer, Office, Deputy Director of Defense Research and Engineering; Charles R. Woodside, Office of the Assistant Secretary of the Army; Brig Gen Wilson R. Reed, CG of the Army Computer Systems Command; and Brig Gen Donald D. Blackburn, Office of the Joint Chiefs of Staff.

HumRRO Reports on Target Tracking Accuracy

Results of individual performance in target tracking accuracy are discussed in *Auditory and Visual Tracking of a Moving Target*, Technical Report 70–4, published for the Office of the Chief of R&D by the Human Resources Research Organization.

Objectives of the research were to determine accuracy of auditory localization of a moving sound source, to compare auditory tracking accuracy with visual tracking, and to assess the influence of response and stimulus variables on auditory and visual performance.

Tests showed that mean auditory tracking location accuracy was not statistically different from visual tracking location accuracy when averaged over all trails and conditions. When an index of total human error was used, however, auditory tracking accuracy was much less satisfactory than visual tracking.

Statistical analysis showed that the mean auditory tracking location error increased as the distance between the observer and target increased. Visual tracking location error, however, remained relatively constant as distance increased. Direction of target movement did not influence accuracy.

HumRRO Division No. 5 at Fort Bliss, Tex., conducted the test under Dr. Robert D. Baldwin, director, while HumRRO was part of the George Washington University. Establishment of HumRRO as a separate nonprofit research organization was announced in September 1969.

Military Support was provided by the U.S. Army Air Defense Human Research Unit, commanded by Maj Alexander D. Bell. The HumRRO test group consisted of Robert A. Donohue, Robert J. Foskett, Lt Col Walter E. Burrell (USA, Ret.) and Dr. Edward W. Frederickson. Donohue and Dr. Frederickson authored the report.

New Committee to Review Air Defense Gun Systems

An Advisory Committee on Air Defense was established in mid-May by the board of directors of the U.S. Army Aberdeen (Md.) R&D Center (ARDC), with Daniel D. O'Neill as chairman.

Representatives of the Ballistic Research Laboratories, U.S. Army Materiel Systems Analysis Agency, and Human Engineering Laboratories form the group.

The mission is to review and coordinate research and engineering activities within ARDC which can make a "substantive contribution" to procedures and methodology for developing, evaluating and optimizing design characteristics of air defense gun systems.

A collateral function is to coordinate the ARDC effort with closely related activities throughout the U.S. Army Materiel Command to avoid duplication, to economize in the use of resources and to provide impetus to other AMC organizations in undertaking new tasks.

AVSCOM Puts Top Priority on ALPHA Activities

Project ALPHA developmental activities at the U.S. Army Aviation Systems Command (AVSCOM) are receiving top priority in preparation for implementation, this fall, of a system involving many Army Materiel Command subordinate commands and AMC logistical functional areas.

Under the guidance of Maj Gen John L. Klingenhagen, CG of AVSCOM, with the assistance of a policy advisory group known as the Command Review Council, the 3-phase 5-year project is progressing as a maximum effort. The objective is to achieve uniformity in systems and automatic data processing equipment supporting these systems for effective accomplishment of the AMC mission.

ALPHA denotes AMC Logistics Program Hardcore Automated. The developing systems includes 25 hardcore files and hundreds of subsystems and programs. Involved are procurement and production, supply management, stock control, cataloging, provisioning, financial control, maintenance, management information system, personnel and transportation.

Planned standardization will encompass, in addition to AVSCOM as a prototype organization for implementation, the Mobility Equipment Command, Missile Command, Munitions Command, Tank-Automotive Command, and Weapons Command.

Standardization of AMC automated systems is part of a long-range plan to improve data management Army-wide. Phase II implementation includes such major files as Federal Stock Number Master Data Record; Materiel Acquisition and Delivery File; Financial Inventory Subsidiary File; and End Item Parameter. Phase III encompasses financial and management data banks and systems not in Phase II.

In Phase I, AVSCOM, in conjunction with other AMC major commands, has been developing the documentation required, including detailed equipment specifications, to implement the Integrated Management Information System. This consists primarily of a data element dictionary, file format and guides, systems and programing specifications, functional operating procedures, file edit and validation criteria printouts, training courses, requirements and plans, automated programs and procedures.

Phase II of ALPHA Conversion is the period when an AMC major subordinate command gets involved by going on line with the standard ALPHA files, systems and programs. This is being accomplished at AVSCOM through the ALPHA Conversion Committee under direction of General Klingenhagen.

Paul L. Hendrickson is the AVSCOM conversion control officer and he has five deputy conversion officers (DCOs) reporting directly to him—DCO for Training, DCO for Site and Equipment, DCO for Test and Implementation, DCO for Bridging and Unique Requirements, and DCO for Files Conversion.

The DCOs, as directed by Hendrickson, levy work requirements on the ALPHA Conversion Action Teams (ACATs) which are responsible for implementing the system in their areas. They are concerned with correlation of data elements, files, systems and programs, training requirements and familiarity with Functional Operating Instructions input and output.

The ACATs analyze files and systems to insure that missions and functions will be covered by the ALPHA system; also, that required systems and files will be bridged or established as stand-alone systems to insure mission accomplishment—or the alternative is that of doing the work manually.

The DCOs direct staff support of the Programs Evaluation and Review Element, including dispersing and control of information and documentation, developing administrative operating procedures, a central library and file of documentation and other management activities.

General F. J. Chesarek, CG of the AMC, has termed ALPHA one of the command's top priority projects. It is linked to TEAMUP (Test, Evaluation, Analysis and Management Uniformity Plan) and will include a U.S. Major Item Data Agency and HQ AMC Data Center.

Importance of the ALPHA system is reflected by the fact that it is under the watchful eye of the Secretary of Defense for Logistics, the Secretary of the Army, the Government Accounting Office, Army Audit Agency and leaders of the AMC commodity commands.

USAEPG Radio-Electronics Pioneer Closes Long Career

Culminating a career in radio-electronics of more than a half-century, James J. Lamb retired recently as chief of Methodology, Research and Development, with the Army Electronic Proving Ground (AEPG), Fort Huachuca, Ariz.

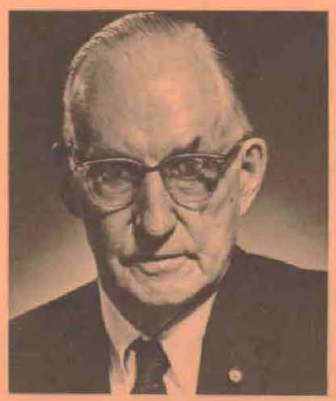
His career began with pre-World War I radio experiments at his Michigan, N.Dak., birthplace. After receiving his degree in electrical engineering from Catholic University of America in 1922, he pioneered radio broadcasting station construction and operation in Grand Forks, N.Dak., where he established KFJM at the University of North Dakota. This was one of the first educational broadcast stations.

Lamb was with HQ American Radio Relay League (1928–40), serving as technical editor of QST magazine and as a research engineer. He was associated for 18 years with Remington Rand and Sperry Rand Univac, retiring in 1959 as a consultant at the Univac Division Laboratory at Norwalk, Conn.

In 1959, he became a member of the technical staff of Ramo Wooldridge, which at that time was working on an Army automatic data processing system project at Fort Huachuca.

In 1961, he entered U.S. Government service as scientific adviser and technical director of the signal communications department of AEPG. In June, 1962, he became chief scientist of the new Army Electronic Research and Development Activity. He remained at Fort Huachuca when that agency was transferred to Fort Monmouth in 1966.

During the past three years he has been responsible for the invention and development of the system known as McSIR, an acronym for Meso-cavity Specular Integrating Refractometer. This system has introduced a new method for real-time measurement of initial atmospheric radio refractive index gradient for radar error correction.



James J. Lamb

Lamb has two patent applications pending on the McSIR system and seven patents prior to his association with the Army. He has authored about 70 technical papers and articles.

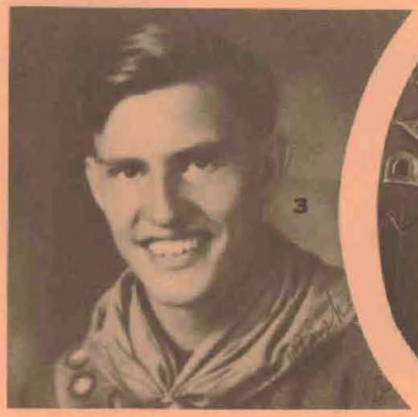
He has been a Fellow of the Institute of Electrical and Electronic Engineers (IEEE) since 1954, and is the only Fellow in the Fort Huachuca IEEE section in which he has been active for the past seven years.

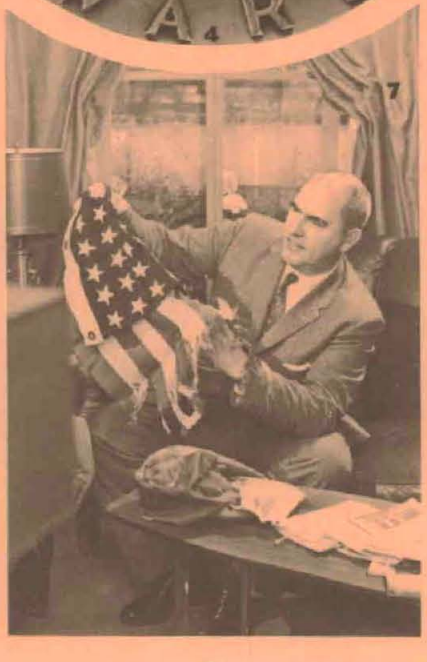
Other awards include: OSCR Certificate of Appreciation (1945), Radio Club of America Fellow (1958), ARRL Technical Merit Award (1959), and the Meritorious Civilian Science Medal from the Electronics Command (1966).

Mr. and Mrs. Lamb have moved from Sierra Vista, Ariz., to Cupertino, Calif., where he plans to continue electronics activity in association with Andromeda Data Systems, Inc.

Medallion Honors Dr. Siple for Lifetime of Army Research

(See story on page 1)





(1) MRS. BYRD, widow of Adm Richard E. Byrd, admires Department of Defense Distinguished Civilian Service Award presented to Dr. Paul A. Siple in 1958 for IGY achievements in the Antarctic. (2) Secretary of the Army Wilber M. Brucker pins Exceptional Civilian Service Medal on Dr. Siple in 1957 as Mrs. Siple observes. (3) Boy Scout Siple, at age 19, when he was selected to go on Adm Byrd's first Antarctic expedition. (4) Silver Medallion (actual size) to be awarded for the first time at the 1970 Army Science Conference. (5) Dr. Siple, as he worked in the U.S. Antarctic IGY Program. (6) Associates and friends, Dr. Leonard S. Wilson, chief, Environmental Sciences Division, U.S. Army Research Office, and Dr. A. Stuart Hunter, scientific director, Natick (Mass.) Labs, 1944–48. (7) Dr. Siple displays American flag flown at South Pole Station during the IGY.

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